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EFFECTS OF THE TIME OF INSEMINATION AND LITTER SIZE ON THE GESTATION LENGTH OF RABBITS

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ABSTRACT: Pannon White nulliparous and multiparous does were divided into two groups and inseminated at 8:00 a.m. (n = 587) or at 8:00 p.m. (n = 548). On the basis of 390 and 346 kindlings respectively, it was established that the 12-hour time difference between inseminations had no effect on the length of gestation (31.73 and 31.67 days, respectively). The time of parturition was also influenced by the time of day. Does most often kindled between 22:00 and 04:00 and least often during the day (between 10:00 and 16:00). Parity significantly influenced gestation length (first parity: 31.42 days, 8th–10th parities: 32.15 days, $P < 0.05$). Litter size at insemination had no effect but litter size at birth exerted a significant effect on gestation length: with the increase of litter size the gestation length shortened (litters of 1 and 2 young: 32.42–32.46 days, litters of 9–14 young: 31.32–31.50 days, $P < 0.05$).

Key words: gestation lenght, parity, litter size, rabbit.

INTRODUCTION

The gestation length of rabbits is well known, and several papers have been published on its influencing factors. According to most data of the literature (MAY and SIMPSON, 1975; MCNITT and MOODY, 1991; EHIOBU *et al.*, 1997), mean gestation length is around 32 days, ranging mainly between 27 and 35 days. In a study conducted by ZUCCHI and DESALVO (1987), 11, 22, 45, 18, 3 and 1% of the does kindled on days 29, 30, 31, 32, 33 and 34 of gestation, respectively. Several authors

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(AFIFI and EMARA, 1985; MCNITT and MOODY, 1991) emphasise the characteristics of the breed. Heritability and repeatability have been found to be very low FERRAZ *et al.*, 1992; FARGHALY, 1996; LUKEFAHR and HAMILTON, 1997). The effect of the seasons is significant (AFIFI and EMARA, 1985; FERRAZ *et al.*, 1991; FARGHALY, 1996). MCNITT *et al.* (1997) observed longer gestation in the summer months which accounted for smaller sized litters. Several authors (ZUCCHI and DESALVO, 1987; KHALIL and SOLIMAN, 1989; FARGHALY, 1996) demonstrated a significant effect of parity on the gestation length; however, the difference was not always clear (AFIFI and EMARA, 1985). While AFIFI and EMARA (1985) as well as ZUCCHI and DESALVO (1987) failed to detect a significant correlation between litter size and gestation length, other authors (AFIFI *et al.*, 1989; MCNITT and MOODY, 1991; FARGHALY, 1996) found that gestation length shortened with increasing litter size. According to the findings of MCNITT and MOODY (1991), gestation length was influenced by the hour of mating during daytime (morning or afternoon).

In the opinion of HUDSON *et al.* (1996), does most often kindle in the morning. Parturition also occurs at other times of the day, but the pre-dawn hours are reserved for nursing. During the peak period of parturition (on gestation day 31) PIMENTA *et al.* (1996) recorded kindlings during the day more often than at night.

The aim of the present experiment is to study the effects of time of insemination (12-hours difference), parity, litter size at insemination and at parturition on the gestation length.

MATERIALS AND METHODS

The study was carried out on Pannon White rabbits at the Anas Agricultural Co-operative rabbit farm. The rabbits were kept in closed houses with windows that allowed alterations in day length to occur naturally. There was neither a cooling nor a lighting system programmed. The animals were kept in flat-deck cages. Insemination was performed on the 7th of June, at 4.5 months of age in nulliparous

does and on the 11th day after parturition in primiparous and multiparous does. In this period the temperature in the rabbit house occasionally reached or exceeded 30°C. Sunrise was at 4:47 and 4:57 while sunset was at 20:40 and 20:40 at the time of insemination and parturition, respectively. In the rabbit house provided with windows the transition from light to dark took place gradually, and in the period between 10:00 p.m. and 4:00 a.m. (i.e. in the period called "dark" in the evaluation) there was complete darkness (a torch was used to check kindlings during the night).

The animals were fed a commercial rabbit diet (energy: 10.3 MJ DE/kg, crude protein: 16.5%, crude fibre: 15.5%) *ad libitum*. Drinking water was provided *ad libitum* from valve drinkers.

Does were divided into two groups at random. One group (n = 587) was inseminated in the morning, between 8:00 and 10:00 a.m., and the other group (n = 548) in the evening, between 8:00 and 10:00 p.m. Simultaneously with the insemination, the does received 1.5 μg GnRH analogue (D-phe6-GnRH, Ovurelin inj. ad us. vet.). Does that were judged to be pregnant by palpation 10 days after insemination, were transferred into a cleaned and disinfected house on the fourth day before the expected date of parturition. There the number of does that kindled and the litter size were recorded at 2-hour intervals starting from the expected date of parturition, i.e. day 29 of gestation at 8:00 hours. Kindling was recorded up to the evening of day 33. By that time 390 and 346 does had kindled in the group inseminated in the morning and in the evening, respectively. As for the remaining groups of 13 and 8 does, respectively, parturition was induced with 5 UI oxytocin; they were excluded from the evaluation. The mean litter size of these does was 2.8.

The length of gestation was calculated on the basis of the length of time elapsed between the actual insemination and kindling (days, hours). The distribution of kindlings was plotted on the basis of the gestation length (Figure 1) and by alternation of day and night (time of the day) (Figure 2). The effect of parity and litter size (at insemination and at kindling) on the length of gestation was determined.

Statistical evaluation of the data was performed by the GLM procedures of the SPSS (version 7.5) for Windows computer program. The applied models and analyses can be seen in Table 1. Significant differences between the groups were calculated by Duncan's test.

RESULTS AND DISCUSSION

Time of insemination

The mean gestation length was 31.70 days. The time of insemination during the day (morning or evening) did not influence the length of gestation (Table 2).

Table 1: Models.

Analysis	Factor	Type	Gestation length (day)	Litter size at parturition
multivariate	time of insemination[a]	F	x	x
	parity	F	x	x
	litter size at insemination	C	x	x
	litter size at parturition	C	x	-
univariate	time of insemination	F	x	-
	parity	F	x	-
	litter size at insemination	C	x	-
	litter size at parturition	C	x	-

[a]inseminated morning or evening, F: fixed factors, C: covariate.

According to MCNITT and MOODY (1991), the gestation length of does mated in the afternoon is significantly shorter (31.99 days) than that of does mated in the morning (32.29 days). This finding apparently conflicts with the data presented in the table.

Table 2: Effect of the time of insemination on the gestation length (days).

Insemination	n	Mean	SE
Morning	390	31.73	0.04
Evening	346	31.67	0.04
Total	736	31.70	0.03

The time of insemination did not significantly affect conception rate or litter size (Table 3).

Distribution of the gestation length

The length of time elapsed between actual insemination and kindling is shown in Figure 1. A kindling peak occurs first in the group inseminated in the morning and then about 12 hours later in the group inseminated in the evening. In both groups, kindling peaks occur repeatedly at 24-hour intervals. This periodic pattern of parturition suggests that the regular changes of the photoperiod also exert an influence on kindling, i.e. on the gestation length.

Table 3: Effect of time of insemination on the conception rate and litter size (total).

				Litter size (total)	
Insemination	No. of AI	Conception rate, %	No. of litters	Mean	SE
Morning	587	66.4	390	8.25	0.14
Evening	548	63.1	346	8.29	0.13
Total	1135	64.8	736	8.27	0.10

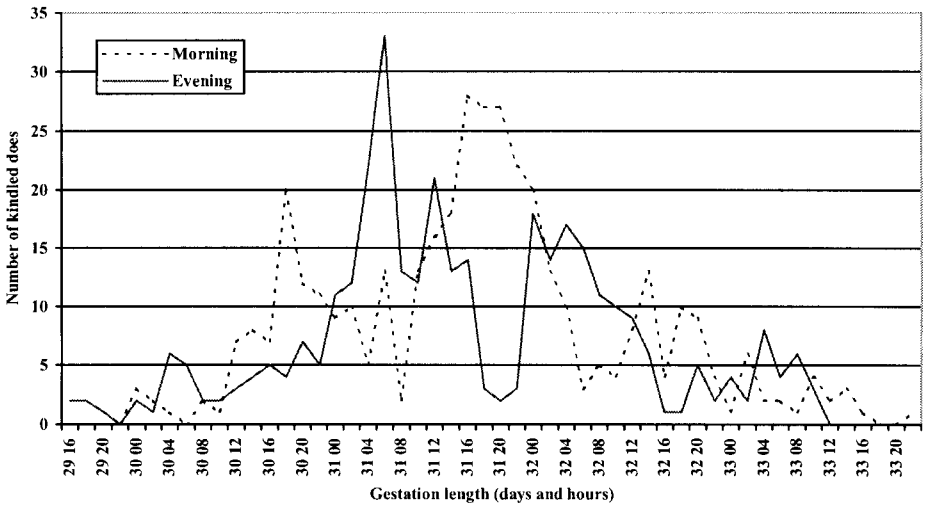

Figure 1: Effect of insemination time on gestation length.

Distribution of kindlings (day and night)

The kindlings were adjusted to the alternation of dark and light period (Figure 2). Accordingly, on the axis of abscissa the time elapsed from the beginning of the first kindling day (9:00 a.m. on day 1) was plotted instead of the time elapsed from insemination. Thus, the figure clearly shows that the kindling peaks occur at night between 22:00 and 04:00. In the daylight period of the 2nd day the number of kindlings decreased despite the otherwise increasing trend, while in the dark period of day 4 it increased despite the otherwise decreasing trend. This tendency contrasts with that described by HUDSON *et al.* (1995, 1996). Kindling is most common during the night, which under natural conditions is the period of activity.

Figures 1 and 2 provide an explanation of why the 12-hour interval between the insemination of the two groups is not reflected in the gestation length. With rabbits inseminated in the morning, the first kindling peak occurs 12 hours earlier (Figure 1). However, because of the alternation of days and nights the most common kindling still occurs earlier in the group inseminated in the evening than it does in the "morning group" (Evening group: 31 days and 6 hours, Morning group: 31 days and 16-18 hours, Figure 1). Such periodic alternation of the kindling peaks eventually blurs

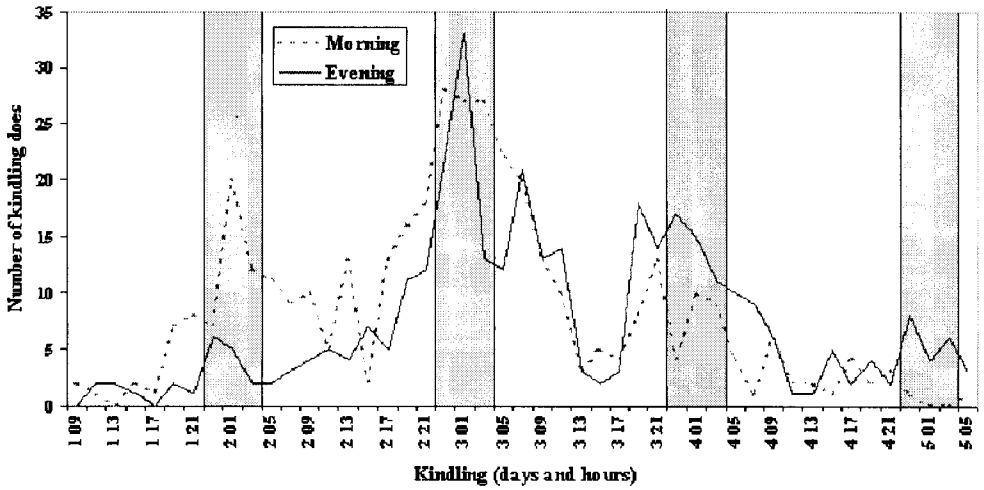

Figure 2: Effects of day and night on number of kindled does.

the time difference between the insemination of the groups. It seems that the dark period is the factor that triggers the parturition, independently from the time of insemination.

Parity

Parity significantly influenced the length of gestation. The gestation length tended to increase with parity: the gestation length of primiparous does (31.42 days) was significantly different from that of does with 8–10 parities (32.15 days) (Table 4).

Our results are consistent with the findings of KHALIL and SOLIMAN (1989) and FARGHALY (1996), who reported that gestation length increases with parity.

Litter size at insemination

The number of young nursed at the time of insemination, which is closely correlated with the milk production of does (TORRES *et al.*, 1979), had no influence on the length of gestation. The gestation length of nulliparous does, does inseminated after weaning (non-nursing does) and nursing does 1–6, 7, 8 and 9–10 kits was

Table 4: Effect of parity on gestation length.

Parities	n	Gestation length (days)	
		Mean	SE
1	198	31.42[a]	0.05
2	146	31.54[ab]	0.06
3	130	31.87[ab]	0.07
4	92	31.83[ab]	0.08
5-7	102	31.92[ab]	0.07
8-10	35	32.15[b]	0.16
10<	33	31.87[ab]	0.14
Total	736	31.70	0.03

Means in the same column with different superscripts differ significantly. $P < 0.05$.

31.44, 31.69, 31.78, 31.88, 31.80 and 31.73 days, respectively. According to these findings, gestation length is not influenced by the number of young that are nursed by the does.

Litter size at parturition

Total litter size and gestation lengths are negatively related: the larger the litter, the shorter the length of gestation (Table 5). The relationship found between the two traits is fully consistent with the results reported by MCNITT and MOODY (1991): does pregnant with 1–2 young had a gestation longer than 33 days, while the gestation of does giving birth to 9–14 young was shorter than 31.5 days.

The results show that while the number of rabbits nursed (i.e. the milk production of the doe) does not affect the length of gestation, litter size does exert an influence on it, which is a general phenomenon typical for mammals.

Table 5: Effect of total litter size on gestation length.

		Gestation length (days)	
Litter size	n	Mean	SE
1	8	32.46^{e}	0.28
2	15	32.42^{e}	0.27
3	15	32.54^{e}	0.28
4	29	32.39^{e}	0.16
5	41	32.14^{de}	0.12
6	60	31.97^{cd}	0.10
7	88	31.87^{bcd}	0.08
8	116	31.65^{abc}	0.07
9	119	31.50^{ab}	0.05
10	111	31.40^{a}	0.06
11	66	31.49^{ab}	0.08
12	30	31.32^{a}	0.13
13	20	31.43^{a}	0.13
14	18	31.36$^{[]}$	0.17
Total	736	31.70	0.03

Means in the same column with different superscripts differ significantly. $P < 0.05$.

CONCLUSION

Length of gestation is independent of whether the doe is inseminated in the morning or 12 hours later, in the evening. Time of kindling appears to be influenced by the alternation of nights and days (parturition being most common at night and least common in daylight periods, around noon and in the early afternoon). Therefore, gestation length is partially independent of the time of day in which the doe is bred. Length of gestation is influenced by parity.

Although milk production and growth of foetuses equally represent a great burden for the doe, number of nursed young at AI shows no relationship with gestation length while litter size (number of foetuses) is related to it.

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