INFLUENCE OF PHOTOPERIOD ON THE SEXUAL BEHAVIOUR OF NON-LACTATING RABBIT DOES: PRELIMINARY RESULTS

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ABSTRACT

The aim of this experiment was to study short term and long term effects of different lighting programmes on the sexual behaviour of rabbit does maintained without production for 18 weeks after their first weaning. Sixty INRA 0067 rabbit does were equally divided into three groups (groups 8, 816 and 16). Four days before the first insemination, they were placed into three identical rooms under a constant 16L:8D lighting programme. The day following the first weaning, three different lighting programmes were applied. For does of groups 8 and 816, the lighting programme suddenly changed from 16L:8D to 8L:16D. Only for group 816, at the beginning of the 10th week, a sudden change was applied from 8L:16D to 16L:8D. During the whole experiment, does of the control group were under a constant 16L:8D light programme (group 16). The experiment lasted 18 weeks. For each group, the sexual behaviour of rabbit does was tested in the presence of a vasectomised buck. The tests were done two times a week for two weeks at different phases during the experiment. For each phase, the receptivity test was considered on day 0 (D0) and 5 days (D5), 7 days (D7) or 12 days (D12) days later. Whatever the phase, under a 16L:8D photoperiod, does were significantly more receptive than under a 8L:16D one (phase 1: 91.3 vs. 77.5%; phase 2: 83.8 vs. 70.0%; phase 3, 76.3 vs. 62.5%). After the light stimulation of group 816, the percentage of receptive does increased from 55% (D0) to 90% (D12) and remained above 80% for one week (D7: 85%, D12: 90%). At the end of the experiment (17th and 18th weeks), the sexual behaviour of rabbit does was significantly ($P<0.001$) related to the lighting programme. For group 816, even seven weeks after a light stimulation, does were more receptive than under a constant 16L:8D photoperiod whatever the testing day. Further studies are necessary to precisely conclude the delay between the light stimulation and the optimal sexual behaviour response and the duration of these effects. Moreover, a better knowledge of subjacent physiological mechanisms is necessary to progress in the control of rabbit reproduction.

Key words: Rabbit, Photoperiod, Light stimulation, Sexual behaviour, Receptivity.

INTRODUCTION

On European rabbit farms, rabbit does are generally inseminated. Because of a strong antagonism between lactation and reproductive functions in non-receptive does, at the moment of insemination lactating non-receptive does have poor performance. Consequently, to reach high levels of fertility, farmers use different hormonal treatments or alternative methods to induce oestrus (Theau-Clément, 2007). The foreseeable evolution of the regulations on the use of exogenous hormones has led to study alternative methods for the improvement of sexual receptivity of rabbits and as a consequence, of their productivity. Lighting programmes, which are easy to apply and are low cost, will be more efficient if the rabbits are in the same physiological state. Therefore, they are perfectly adapted to cycled production (all the does of a same batch are inseminated on the same day) generally adopted in rabbit production. Moreover, lighting programmes are widely used in avian species (Chemineau *et al*., 1992). The results of Hammond and Marshall (1925) and Boyd (1986) on wild rabbits suggested, that fertility is maximal with increasing day length. Except for Schüddemage *et al.* (2000), who compared to a constant 8 h light/day, it is generally concluded that rabbits does have higher productivity under an

artificial light duration greater then 14 h per day (Walter *et al*., 1968; Uzcategui and Johnston, 1992; Theau-Clément and Mercier, 2004). Moreover, previous studies have already demonstrated the efficiency of a light stimulation, such as a sudden increase from 8 to 16 h of light per day 7 days before insemination, on rabbit fertility (Theau-Clément *et al*., 1990; Mirabito *et al*., 1994). Thus, the aim of this experiment was to study short term and long term effects of different lighting programmes on sexual behaviour of rabbit does, maintained without production during 18 weeks after their first weaning.

MATERIALS AND METHODS

Animals and experimental design

The experiment was performed at INRA (E.A.S.M. Magneraud, France). A total of 30 vasectomised bucks and 60 primiparous INRA 0067 rabbit does, exposed to 8 h light per day during the fattening period, were used. Rabbit does were equally divided into three groups according to their genealogy (sisters distributed in the three groups) and weight at the moment of being placed in the definitive experimental room. Four days before insemination, the does (18 weeks old at insemination) were suddenly placed into three identically environmentally controlled rooms under a constant 16L:8D lighting programme. In each side of each room, 9 fluorescent tubes (white light) were placed in front of the cages at 1.7 meters high. The mean light intensity was measured in the centre of each cage (from 100 to 240 lux, room 1: 173 ± 25, room 2: 164 ± 22, room 3: 195 ± 21 lux,) at the rabbit eye height. The day after the first weaning (young rabbits 30 days old), three different lighting programmes were applied (Figure 1). For does of groups 8 and 816, the lighting programme suddenly changed from 16L:8D to 8L:16D (lights-off at 1 p.m.). Only for group 816, at the beginning of the 10th week, a sudden change was applied from 8L:16D to 16L:8D (lights-off at 9 p.m.). Control does (group 16) were under a constant 16L:8D light programme (lights-off at 9 p.m.). Whatever the programme, the light was switched on at 5 a.m. The experiment lasted 18 weeks. For each group, the sexual behaviour of the rabbit does was tested in the presence of a vasectomised buck as described by the International Rabbit Reproduction Group (2005). The tests were done twice a week for two weeks, at different times during the experiment: the first two weeks (phase 1), the 8th and 9th week for groups 8 and 16, or because of the sudden change from 8 to 16 h light/day, the 10th and 11th weeks for group 816 (phase 2) and the 17th and the 18th weeks for all groups (phase 3). For each phase, the receptivity test was considered on day 0 (D0) and 5 days (D5), 7 days (D7), and 12 days (D12) later. The animals were housed in individual flat-deck cages. During the whole experiment, rabbit does were maintained without any insemination. In order to avoid an excessive gain of weight, they received 140 g/day of a commercial pellet diet containing 16.5% crude protein and 15.5% crude fibre. Water was provided *ad libitum*.

Statistical Analysis

The percentage of receptive does (taking a lordosis position in the presence of a buck) was analysed as a Bernoulli variable (range 0-1) by analysis of variance like a classical continuous variable. Since the physiological status of the does was different at the first phase (lactating until the day before the change of the lighting programme), the percentage of receptive does was analysed taking into account the fixed effect of the lighting programme (3 levels: 8, 16, 816), the testing day (4 levels: 0, 5, 7, 12) and the interaction between both of them. During phase 2, because data collections were not contemporaneous, the sexual behaviour was studied using the same statistical model comparing groups two by two.

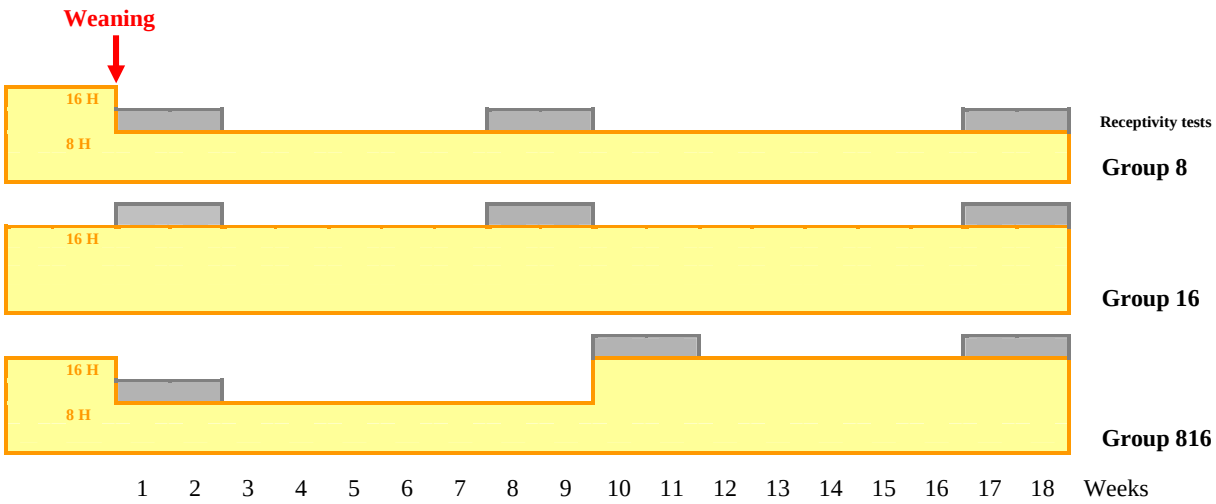

Figure 1: Experimental design. In grey: receptivity tests at days 0, 5, 7, and 12

RESULTS AND DISCUSSION

During the experiment, 720 sex behaviour tests were done. The percentage of receptivity was 78.8 ± 40.9%. Figure 2 illustrates the kinetics of the percentage of receptive does according to the phase, the lighting programme and the testing day.

Phase 1. During the first phase, receptivity rate significantly varied according to the lighting programme (Table 1). Under a 16L:8D photoperiod, does were more receptive than under a 8L:16D one (91.3 vs. 77.5%, P=0.044). The oestrous behaviour did not significantly vary for groups 8 and 816. This result is relevant since at the beginning of the experiment, the lighting programmes of both groups were strictly the same. Whatever the lighting programme, there was a clear increase in the percentage of receptive does 5 days after the stimulation (66.7 vs. 86.7% for DO and D5, respectively, P=0.002). Then, the evolution of the receptivity rate was not significant (90.0 and 88.3% for D7 and D12, respectively). The increase of the oestrous behaviour obtained for the control group (no lighting programme change) could be an oestrous induction after the Dam-Litter Separation (DLS) at weaning (Theau-Clément, 2007). For groups 8 and 816, the oestrus induction on day 5, could be the cumulative effect of the photoperiod change on day 0 and the dam-litter separation the day before. Whatever the stimulation (lighting programme + DLS for groups 8 and 816 or only a DLS for the control group), the percentage of receptive does was greater than 80% on days 7 and 12. This result could suggest that after a stimulation, receptivity is improved 5 days later and remains at a high level for at least a week.

Phase 2. Comparing groups 8 and 16, under a 16L:8D lighting programme, rabbit does were clearly more receptive (83.8 vs. 70.0%, P=0.040) whatever the testing day. When comparing the oestrous behaviour of does from groups 8 and 816 which consisted in comparing the efficiency of a light stimulation (from 8L:16D to 16L:8D) the effect was not significant. After the light stimulation of group 816, the percentage of receptive does increased from 55% (D0) to 90% (D12). It can be suggested that the receptivity improvement clearly appears one week after the stimulation and too late to evidence a significant effect. Comparing the sexual behaviour of does belonging to groups 16 and 816, a significant interaction was evidenced between the lighting programme and the testing day (P=0.038). Since, for group 16. the percentage of receptive does did not significantly vary according to the testing day, for group 816, there was a significant improvement of does receptivity 7 days after the light stimulation (from 55 to 75%, respectively) which was maintained for one week (D7: 85%, D12: 90%). This result suggests that for group 816, the light stimulation is effective on rabbit sexual behaviour one week later.

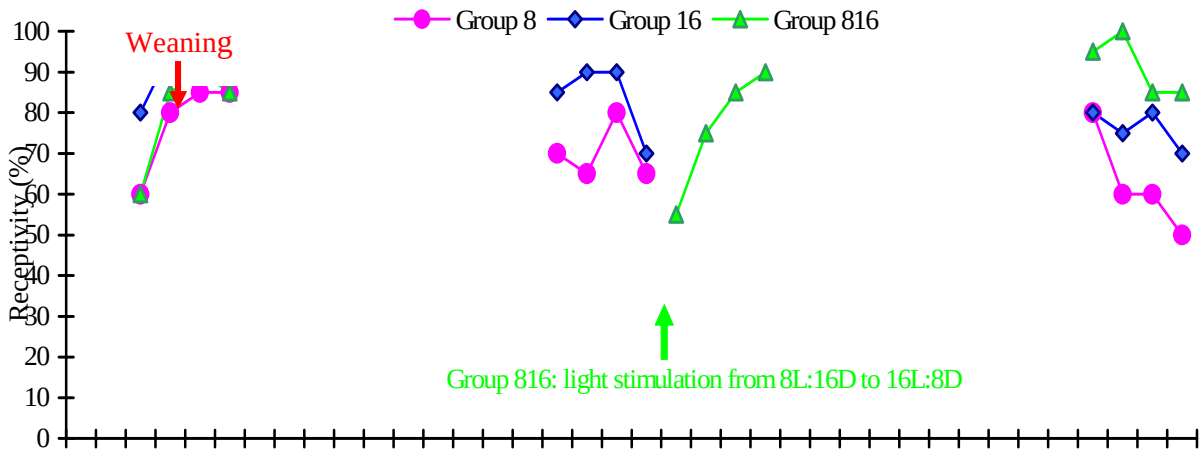

Figure 2: Evolution of the percentage of receptive does according to the lighting programme, the phase, and the testing day. Group 16 is the control group with no change in lighting programme (16L:8D)

Table 1: Influence of photoperiod on rabbit does sexual receptivity. Results of variance analysis (least-squares means)

	Number	Phase 1	Phase 2			Phase 3
			8 vs. 16	8 vs. 816	16 vs. 816	
General mean (%)	*720*	82.9	76.9	73.1	80.0	76.7
Residual standard error		36.8	42.0	44.1	39.2	40.9
R^2		*9.25*	5.60	6.02	*8.60*	*11.0*
Group		*	*	NS	NS	***
8	*240*	77.5 a	70.0	70.0	-	62.5 a
16	*240*	91.3 b	83.8	-	83.8	76.3 b
816	*240*	80.0 ab	-	76.3	76.3	91.3 c
Testing day		**	NS	NS	NS	NS
Day 0		66.7 a	77.5	62.5	70.0	85.0
Day 5		86.7 b	77.5	70.0	82.5	78.3
Day 7		90.0 b	85.0	82.5	87.5	75.0
Day 12		88.3 b	67.5	77.5	80.0	68.3
Group x Testing day		NS	NS	NS	*	NS

NS: P>0.05; *: P<0.10; **: P<0.01; ***: P<0.01. Within columns, means with different letters are significantly different P<0.05

Phase 3. During the 17th and 18th weeks of the experiment, the sexual behaviour of rabbit does was significantly (P<0.001) related to the lighting programme. Under a constant 8L:16D lighting programme, does evidenced a lower receptivity than under a 16L:8D one (62.5 vs. 76.3 %). But for group 816, even seven weeks after a light stimulation (from 8L:16D to 16L:8D), does were more receptive than under a constant 16L:8D photoperiod whatever the testing day. This result underlines the strong effect of a light stimulation and could suggest a quite long duration. To avoid remnant effects of the sex behaviour tests, the does receptivity was not studied during the whole experimental period. Consequently, we cannot precisely conclude on the duration of these effects.

CONCLUSIONS

On rabbit does maintained without production for 18 weeks after their first weaning, the receptivity rate was significantly higher under a 16L:8D photoperiod than under a 8L:16D one. Moreover, a light stimulation from 8L:16D to 16L:8D clearly improved the rabbit does sexual behaviour one week later. Further studies are necessary to precisely conclude on the delay between the light stimulation and the optimal sexual behaviour response and the duration of these effects. A better knowledge of the different effects of photoperiod on neuroendocrine pathways is necessary to progress in the control of rabbit reproduction.

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