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INFLUENCE OF BODY LIVE WEIGHT AND RELOCATION ON KINDLING RATE AND PROLIFICACY IN ARTIFICIALLY INSEMINATED NULLIPAROUS DOE RABBITS

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ABSTRACT

Sixty-four and ninety-four New Zealand White nulliparous doe records from two trials were used for analysis in order to determine the effect of body live weight score (BWS), sexual receptivity (SR) and management procedure (MP) on kindling rate (KR), total born (TB) and born alive (BA) per litter. Does in trial 1 were not relocated before insemination while rabbits in trial 2 were subjected to a change of place and cage 8 hours before service. Body weight records were arranged in three score groups: S1 = 3180 – 3300, S2 = 3301 – 3500 and S3 = >3500 g. BWS had no influence on receptivity rate (RR). Values for S1, S2 and S3 were 0.59, 0.60 and 0.60 respectively. There was a highly significant ($P < 0.0001$) effect of management on the onset of oestrus. RR in non-relocated (0.41) was lower than in relocated (0.78). BWS had no influence on KR, TB and BA ($P > 0.05$). KR for S1, S2 and S3 were 0.92, 0.86 and 0.86 with TB values of 7.27 ± 0.48 , 8.22 ± 0.34 and 7.32 ± 0.66 respectively. KR was influenced by SR ($P < 0.04$). Receptive does had significantly greater KR (0.91) than non-receptive (0.85). TB in these categories were 7.75 ± 0.33 and 7.46 ± 0.49 but no significant differences ($P > 0.05$) were observed. There was a significant effect of MP on TB ($P < 0.0002$) and BA ($P < 0.001$). TB and BA in non-relocated does were 6.86 ± 0.38 and 6.51 ± 0.38 while litter size values in relocated were 8.34 ± 0.45 and 7.87 ± 0.45 respectively.

INTRODUCTION

Doe rabbits reach puberty between the 11th and 14th weeks of age based on receptivity and ovulatory response (HULOT *et al.*, 1982) and a considerable number of pre-ovulatory follicles were observed at these ages (GOSALVEZ *et al.*, 1989). DIAZ *et al.* (1991) found a positive development of reproductive potential of does from 14 to 20 weeks of age based on follicle stimulating (FSH) and luteinizing hormone (LH) levels. According to LEBAS and COUDERT (1986) first mating may be carried out between the 16th and 18th weeks of age without impairing breeding results at first kindling and doe productivity. However, GOSALVEZ *et al.* (1994) pointed out that in practice the first service is carried out at 20 weeks of age when does have completely developed their reproductive structures. They recommended starting breeding as soon as does reach 75% of the adult body weight.

In nulliparous doe rabbits, enhancement of follicular growth and oestrus synchronization have been achieved by feeding control and flushing (HULOT *et al.*, 1982; GOSALVEZ *et al.*, 1994). This has also been possible by keeping young does under a constant photoperiod from weaning until puberty (KAMWANJA and HAUSER, 1983) and by means of sudden change of does to another cage or environment (LEFEVRE *et al.*, 1976; LEFEVRE and MORET, 1978; REBOLLAR *et al.*, 1995). However, there is little information on the effect of relocation and age or weight of does at first service on reproductive performance under artificial insemination (AI) programmes. The aim of the present study was to evaluate the effect of body weight and

relocation on reproduction in artificially inseminated nulliparous doe rabbits.

MATERIALS AND METHODS

Data from two trials undertaken at the experimental station "Conejos" Centro de Investigación Científica del Estado de Mexico A.C. were used for statistical analysis. The trials were carried out in May 1990 and July 1996. The station has a longitude of 19°27' N and 98°53' W and is located at 2240 meters above sea level. The climate is temperate with an average yearly temperature of 15° C. Similar management and environmental conditions were given to the does in the two trials. The rabbits were kept in the same unit with natural ventilation system and thermal insulation. Does were maintained in 90 x 60 x 40-cm individual wire cages disposed in a flat-deck system provided with automatic watering and j-feeders. Does received a constant 16 hours light and 8 hours dark schedule daily from the beginning of the experiments.

Sixty-four nulliparous New Zealand White does in trial 1 were not subjected to a change of place and cage before insemination while in trial 2, 94 rabbits of the same breed were relocated for 8 hours before service. Rabbits in trial 2 were moved to a separate room within the same unit no more than 20 meters away and allocated individually in 45 x 60 x 40 cm wire cages disposed in a flat-deck system complex of 14 spaces distributed in two lines. Changes of does were made in groups to this cage complex at 8.00 a.m. and AI was performed at 4.00 p.m. The rabbits were taken back to their original cages immediately after service. At the beginning of the two trials does were about 12 weeks of age and weighed between 2400 and 2600 g. First service in the two trials was performed between the 16th and 18th weeks of age when does weighed between 3180 and 3860 g.

Two available commercial pellet diets were used. The chemical composition of the diet used in trial 1 was 16.7% crude protein, 3.8% fat, 16.7% crude fibre and 2220 kcal digestive energy per kg while the corresponding values in trial 2 were 15.5%, 2.0%, 15.0% and 2180 kcal respectively. Rabbits received both diets *ad-libitum* until they reached 3-kg body weight and were then restricted to 120 g per day until a positive pregnancy diagnosis was confirmed. Pregnant does received free access to food. Does moved were not provided with food while they remained in the separate room before service.

The collection of semen in both trials was made according to the method of WALTON (1945) with the help of a teaser female. Ejaculates were kept in a water bath at 31° C and used within an hour after collection. Samples with milky and creamy appearances and motility scores greater than 75% were selected and pooled into a phosphate buffered saline solution (Dulbecco A, Oxoid). AI was heterospermic. The dilution rates varied between 1/4 to 1/12 depending on the number of does to be inseminated in one day. Does were restrained individually in a supine position and inseminated 6 cm deep inside the vagina, with an English type pyrex pipette giving a dose per doe of 0.8 ml of fresh semen. This assured that each doe received at least ten million motile spermatozoa per dose. For ovulation induction does were injected i.m. immediately after insemination with 0.2 ml gonadotrophin releasing hormone (Conceptal, Hoechst). The same technician did all inseminations. Each doe was placed in a circular cage with a vigorous male fitted with a nappy immediately after insemination and ovulation induction was completed. Does that exhibited lordosis were considered to be receptive, and those, that did not after several copulation attempts by the buck, were considered non-receptive.

Inseminated does were grouped by body weight scores (S1 = 3180 - 3300, S2 = 3301 -

3500, S3 = 3501 - 3860 g), sexual receptivity (receptive and non-receptive), and management procedure (relocation and no-relocation). Receptivity and kindling rates were treated as a variable of BERNOULLI (variable 0-1). Receptivity rate was analysed by analysis of variance. The model included the main effect of body weight score, management procedure and their interaction. Kindling rate and total litter size at birth were analysed with the following statistical model:

$$Y_{ijkl} = \mu + W_i + R_j + M_k + (WR)_{ij} + (WM)_{ik} + (RM)_{jk} + (WRM)_{ijk} + e_{ijkl}$$

Where:

Y_{ijkl}	observed trait value.
μ	overall trait mean.
W_i	fixed effect of i^{th} weight score group ($i=1, 2, 3$).
R_j	fixed effect of j^{th} receptivity group ($j=1, 2$).
M_k	fixed effect of k^{th} management group ($k=1, 2$).
$(WR)_{ij}$	interaction between weight score group and receptivity.
$(WM)_{ik}$	interaction between weight score group and management.
$(RM)_{jk}$	interaction between receptivity and management.
$(WRM)_{ijk}$	interaction among weight score group, receptivity and management.
E_{ijkl}	random error.

Traits were analysed by least squares analysis of variance for unequal subclass numbers using the GLM procedure of SAS (1988). Results presented in the text and tables are least square means with standard errors.

RESULTS

Overall, kindling rates in trial 1 and 2 were 0.83 and 0.87 with a total litter size of 7.00 ± 0.31 and 8.23 ± 0.25 kits, respectively. The average age of does at first service for S1, S2 and S3 were 16.00 ± 0.04 , 16.80 ± 0.04 and 18.4 ± 0.06 weeks with body weights of 3199 ± 8.52 , 3358 ± 8.19 and 3676 ± 12.45 g respectively.

The effect of management procedure and body weight score on receptivity rate is shown in Table 1. Body weight score did not affect receptivity rate ($P>0.05$). However, does that were not moved had decreased receptivity as weight score increased whereas in relocated rabbits values increased as the scores increased. Non-relocated does had significantly ($P<0.0001$) lower receptivity rates (- 37%) than relocated. The interaction between body weight score and management procedure on sexual receptivity was not significant.

Table 1. Effect of body weight score and management procedure on receptivity rate.

Management procedure	Body weight score			Mean \pm s.e.
	S1	S2	S3	
Without changes	0.50 ± 0.19 (6)	0.40 ± 0.08 (37)	0.33 ± 0.10 (21)	0.41 ± 0.08^a (64)
With changes	0.68 ± 0.06 (56)	0.80 ± 0.08 (30)	0.87 ± 0.16 (8)	0.78 ± 0.06^b (94)
Mean \pm s.e.	0.59 ± 0.10 (62)	0.60 ± 0.06 (67)	0.60 ± 0.10 (29)	

() - Number of does. - ^{ab} Figures in the same column with differing superscripts differ ($P<0.0001$).

The fixed effects of body weight score, sexual receptivity and management procedure on kindling rate, total born and born alive per litter are shown in Table 2. Kindling rate in S1 was higher than

S2 and S3. However, there was no significant effect of body weight score or management procedure on this trait. Kindling rate was influenced ($P < 0.04$) by sexual receptivity. Receptive does had a significantly higher kindling rate (+ 6%) than non-receptive.

Total born for S2 was nearly 1 kit greater than S1 and S3 but no significant differences were observed between the groups of does. The effect of weight score on total born per litter in relation to management is shown in Figure 1. Total born follows a similar pattern for scores in the two management procedures. However, relocated does had consistently higher litter size at birth than non-relocated. There were highly significant effects of management procedure on total born and born alive per litter. Relocated does had, on average, more total rabbits born (+ 1.48) and born alive (+ 1.36) per litter than non-relocated. Interactions between main factors were not significant.

Table 2. Effect of body weight score, sexual receptivity and management procedure on kindling rate and litter size at birth.

Factor	N	Kindling rate	N	Total born/litter	Born alive/litter
Body weight score					
S1	62	0.92 ± 0.07	54	7.27 ± 0.48	6.73 ± 0.49
S2	67	0.86 ± 0.05	58	8.22 ± 0.34	7.76 ± 0.34
S3	29	0.86 ± 0.10	23	7.32 ± 0.66	7.07 ± 0.66
P value		0.593		0.096	0.172
Sexual receptivity					
Receptive	94	0.91 ± 0.05^b	85	7.75 ± 0.33	7.38 ± 0.33
Non-receptive	64	0.85 ± 0.08^a	50	7.46 ± 0.49	6.99 ± 0.48
P value		0.045		0.256	0.244
Management procedure					
Without changes	64	0.88 ± 0.06	53	6.86 ± 0.38^a	6.51 ± 0.38^a
With changes	94	0.88 ± 0.07	82	8.34 ± 0.45^b	7.87 ± 0.45^b
P value		0.846		0.0002	0.001
R ²		0.047		0.181	0.136

^{ab} – Figures in the same column within treatment with differing superscripts differ at the levels of probability shown in the table.

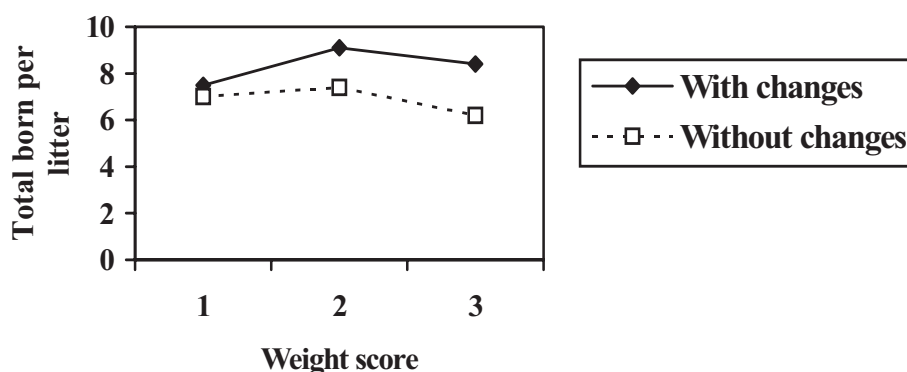


Figure 1. Effect of weight score on total rabbits born per litter in relation to management procedure.

DISCUSSION

Does were inseminated between the 16th and 18th weeks of age and differences in reproductive performance between body weight score groups within this age ranges were not observed. These results are in agreement with LEBAS and COUDERT (1986), who found no differences on breeding results at first kindling when does were 16 to 18 weeks old at service. The high fertility and prolificacy levels attained in our study probably relates to an adequate follicular growth and the presence of a great number of pre-ovulatory follicles. DIAZ *et al.* (1991) found an increase in FSH concentrations between the 14th and 20th week of age and suggested that this may be the origin of the increase of pre-ovulatory follicles within this age range reported by GOSALVEZ *et al.*(1989).

Relocated does had significantly higher receptivity rates than non-relocated. Results are similar to the investigations carried out by LEFEVRE *et al.* (1976) and LEFEVRE and MORET (1978) who found that a sudden change of environment facilitated the onset of oestrus in nulliparous does. These authors suggested that such change may be related to corticosteroid or prolactin release in blood but the exact endocrine mechanisms had not been yet established. In our study it is probably that the maintenance of constant lighting and adequate environmental conditions may have acted synergistically with doe cage changes to enhance follicular growth and to induce the onset of oestrus. Oestrus synchronization by maintaining a constant lighting schedule from weaning to puberty has been reported (KAMWANJA and HAUSER, 1983) and a positive response to cage changes was observed only when does were moved to more favourable environmental conditions (MAERTENS and OKERMAN, 1987). What is not clear at present is whether relocation effect was mediated through space restriction or the proximity of other females.

The kindling rate in relocated does is slightly higher than the 81.8% reported by REBOLLAR *et al.* (1995) who carried out changes of cages 48 hours before AI. This indicates that short-term relocation might be as effective as longer term. Relocation was shown to increase the number of rabbits born per litter and this is explained by the high percentage of receptive does in this trial (73.4% versus 39.1% in non-relocation). Several studies have demonstrated that prolificacy in artificially inseminated rabbits is higher in receptive than non-receptive (THEAU-CLEMENT and ROUSTAN, 1980;THEAU-CLEMENT *et al.*, 1996). Receptive does generally exhibit a higher number of large follicles (KERMABON *et al.*, 1994) and higher oestrogen levels compared to non-receptive (REBOLLAR *et al.*, 1992). The best prolificacy response in this study was observed in relocated does inseminated between 3301 and 3500-g body weight score when they had, on average, 74.6% adult body weight. The present study confirms the efficacy of relocation to increase reproduction in nulliparous does. More research is required to explain the hormonal mechanism that triggers the onset of oestrus in response to the relocation stimuli.

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