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EFFECT OF POST-PARTUM MATING INTERVAL ON REPRODUCTIVE AND PRODUCTIVE PERFORMANCE OF RABBITS

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SUMMARY

Twenty-four does of each New Zealand White (NZW) and California (Cal.) rabbits of 8 months of age, weighing 3.0-4.0 Kg were used in this experiment. After the first parity, does from each breed were divided according to post-partum (PP) period of mating into three groups. Does were mated after 1, 7 and 28 days after parturition in group 1, 2 and 3, respectively.

Reproductive and productive data were recorded for three consecutive parities (2, 3 and 4) for each individual doe.

The highest conception rate (CR) was recorded for does in the group mated after one day of parturition (M1), followed by the does mated at 28 days PP (M3) and the lowest CR was observed for the does mated after 7 days of parturition (M2). Remating interval and parity had significant effect on conception rate. Results showed that CR was higher for Cal. than NZW rabbits. Number of services per conception and gestation period length were not affected by remating interval in both breeds.

Generally, average litter size either at birth or at weaning was greater in Cal. than in NZW breed, significantly for does mated on the first day of PP than those mated at 7 or 28 days of PP.

Blood plasma progesterone (P4) concentrations (ng/ml) of NZW does was ($P<0.01$) higher than Cal. through pregnancy and the late remated does had insignificantly higher plasma P4 concentrations than those remated earlier. The peek value of plasma P4 was observed at the 14 *th* day then decreased until day 21 of pregnancy.

Early remating system increased the marketable meat but with more feed consumption than those late remated.

Keywords: Rabbit, post-partum mating interval, progesterone, conception rate, litter size

INTRODUCTION

Remating interval is one of the most important items in the managerial regimes since it is a limiting factor of the success in the conception rate for each parity.

consequently the sequences of parities within a given period. Commercial rabbit breeding aims at having more litters per year. This intensive rabbit production requires more studies of their behavior and physiological function particularly in the field of reproduction.

Conception rate (Torres *et al.*, 1977 and Lamb *et al.* 1991) and litter size at birth (Sudan *et al.*, 1979) were found to be unaffected by early remating. However, suckling was reported to have an adverse effect during the 10 days after parturition on fertility and prolificacy (Partridge *et al.*, 1984).

Litter size in rabbits is an important reproductive trait which contributes to the expression of the reproductive capacity of the doe. Litter size depends on the number of ova shed at ovulation, those fertilized and those developed to full term. Litter size is controlled by genetic as well as different non-genetic factors. Managerial system, particularly mating regime, have pronounced impact on litter size.

Progesterone is the major agent which control success of pregnancy, litter size and effective lactation.

The objectives of the present study was to evaluate the effect of remating interval and parity on reproductive and productive performances of New Zealand and California rabbits under the Egyptian environmental conditions.

MATERIALS AND METHODS

This work was carried out at the Rabbitry of El-Kanater Research Station of the Agriculture Research Center, Ministry of Agriculture and Physiology Research Lab., Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

Animals

Twenty four does of each New Zealand White (NZW) and California (Cal.) rabbits weighing 3.0- 4.0 Kg and aging 7-8 months were used in this study. Thus the does were considered to be sexually mature to give the 1st parity and consecutive parities throughout the experimental period. Body weight of each doe was recorded monthly to make sure that the physical status is maintained in good condition. Does were housed separately in individual wired cages and fed commercial concentrate pellets *ad-libitum*. Forced mating of does was twice executed to bucks of proven fertility. Those failed to conceive as proven by pulpation were remated immediately . Does were divided according to post-partum period of mating into 3 groups. Those in the first group were mated immediately after parturition (M_1), females in the second group were mated 7 days post - partum (M_2) and does in the third group were mated 28 days post-partum (M_3) (after weaning), for parities next to the first.

Experimental procedures

Conception rate(CR) as the percentage of pregnant does from the first service post-partum, No. of services per conception, gestation period (GP) length, litter size and weight at birth (LSB and LWB) were recorded.. Litter size and weight at weaning (LSW and LWW) and litter weight at 8 weeks of age (LW8) were determined. Pre-weaning mortality (PWM), Feed intake of does (FID), feed intake of litters (FIL) and bunny weight from 5 to 8 weeks of age were also measured. Blood samples, were withdrawn from the ear vein before mating (0 day) then at 7 14 and 21 days during

pregnancy. Plasma samples were prepared by centrifugation (3000 rpm for 15 minutes). and stored at -18 °C until progesterone hormone assay. Plasma progesterone levels were determined using Radioimmuno-assay (R.I.A.) technique.

Data of CR., LSB and LSW were statistically analyzed as Three Factor Factorial Complete Randomized Design (CRD). The factors were breed (B), remating interval (M) and Parity (P). Data of gestation period(GP) length, Number of Litters, LWB, LWW, LW8, FID, FIL and PWM were statistically analyzed as Two Factor Factorial Complete Randomized Design, where factors were breed (B) and remating interval (M). The above two statistical analyses models were performed using the MSTAT (version C), Michigan State University (1984). Data of No. of services were analyzed using the General Linear Model (GLM) procedure of SAS (1988). Data of plasma P4 concentrations were statistically analyzed using procedure of SAS (1988), Duncan's Multiple Range Test was used to separate means whenever, the main effects were significant.

RESULTS

The highest mean values of CR were observed in does mated at day 1 PP (M1), followed by that of does mated at day 28 PP (M3) and the lowest CR. was found in does mated at day 7 PP (M2) (Fig. 1). The CR decreased by about 30.9% and 21.4% in the 3rd and the 4th parity, respectively. The differences due to RI, breed and parity were significant (Table 1, Fig. 1 and 2).

Table 1 revealed that the group of does mated on the 28 *th* day P.P. showed the least number of services per conception while, that mated on the 1st day P.P. had the highest number of services per conception.

Results in Table 1 show that the rabbit does in the 3rd parity needed the greatest number of services per conception (1.71).No. of services per conception was found to be unaffected significantly by breed, remating interval and parity.

The average length of the GP. was found to be unaffected by extension of RI. and breed, hence slight differences were noticed (Table 2).

The average of LSB was higher in Cal. rabbits than in NZW rabbits (Table 1). Does mated at 1st day after parturition associated with the highest litter size at birth. The highest average of LSB was observed at 3rd parity followed by 2 *nd* and 4*th* parity in the two breeds.

The differences between RI groups, breeds and parities for LSB were not significant. These results agree with Ibrahim (1985), Khalil *et al.* (1988) and Hussein (1995).

Progesterone concentration through pregnancy, was higher in cases of mating on the 7th and the 28th days than in case of mating on the 1st day P.P., however the differences were not statistically significant (Fig. 3). Concentration of $P_4$was higher in plasma of NZW than Cal. does by about 21.7% (Fig. 4).

Levels of P4 increased significantly at the 7th day of pregnancy and rose steadily to a peak at day 14 then decreased significantly at the 21st day of pregnancy reaching levels that were still significantly higher than those recorded in the rabbits before mating (Figures 3 and 4).

Effect of RI on LSW. was found to be insignificant (Table 1). Similar results were obtained by Partridge *et al.*(1984), Askar (1989) and Yamani *et al.* (1992). Any how does mated on the 1st day PP gave greater LSW, this might be attributable by the

highest LSB (Table 1) The average of LSW was higher in Cal than NZW rabbits (Table 1) This result was expected because of higher LSB and lower pre-weaning mortality rate in Cal. than NZW rabbits in this study. The average of LSW decreased with the advance of parity (Table 1) This results in agreement with Hussein (1995)

Table 1 Reproductive performance of rabbits as affected by Breed, remating interval and Parity (means and S.E.)

Item	CR	LSB	LSW	No. of services/ conception
Breed				
NZW	52.4[b]	6.4	2.6	1.46
Cal.	69.0[a]	7.6	3.6	1.39
S.E.	5.0	0.4	0.5	0.32
Remating interval				
1 day PP	69.6[a]	8.3	4.6	1.62
7 days PP	48.2[b]	6.8	2.0	1.41
28 days PP	64.3[a]	5.9	2.9	1.24
S.E.	6.1	0.4	0.8	0.34
Parity				
2nd	83.3[a]	7.0	3.6	1.31
3rd	52.4[bc]	7.5	3.2	1.71
4th	61.9[b]	6.6	2.6	1.26
S.E.	7.0	0.4	0.6	0.32

[a,b,c] Means within each trait in the same column having different superscripts differ significantly ($P < 0.05$)

California. does had greater number of litters than NZW does, this difference was significant (Table 2). This result may be due to more adaptation of Cal. than NZW rabbits to Egyptian conditions and /or particular reproductive efficiency which need extensive investigation. NZW was more responsive to the earliest PP remating, on the 1st day, than Cal., the number of parities obtained within the experimental period (6 months) increased by 80 % in NZW *vs.* 40 % in Cal. over that obtained when remating was postponed to the 28th day PP.

The physiological performances, reported in this study, as affected by remating intervals in the two studied breeds within three parities, is apt to be reflected on the productive performance of marketable bunnies.

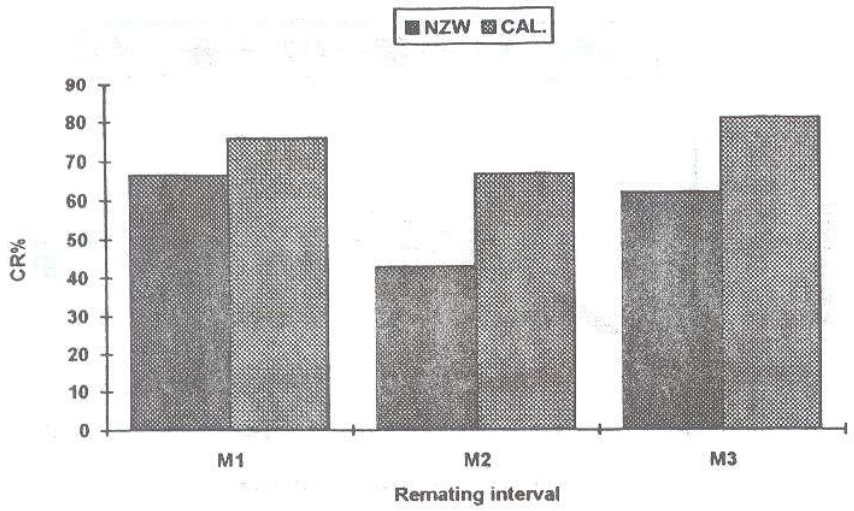

Figure 1. Effect of remating interval on conception rate (CR%) of NewZealand and Calfornian rabbits.

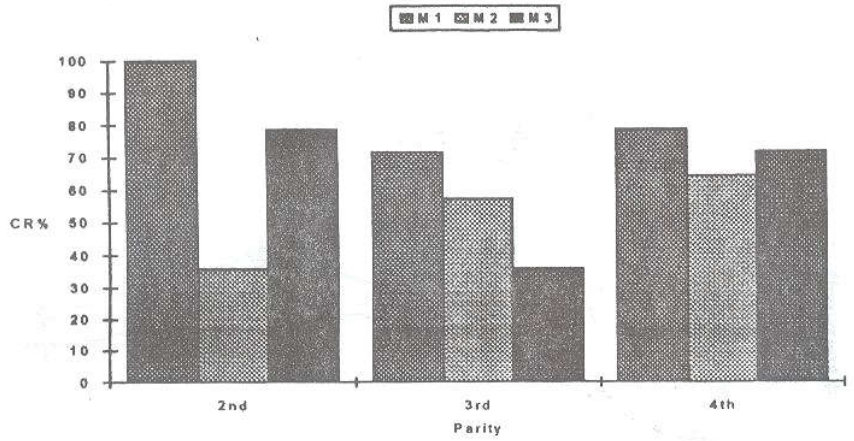

Figure 2. Effect of remating interval and parity on conception rate (CR%) as averages for NewZealand and Calfornian rabbits

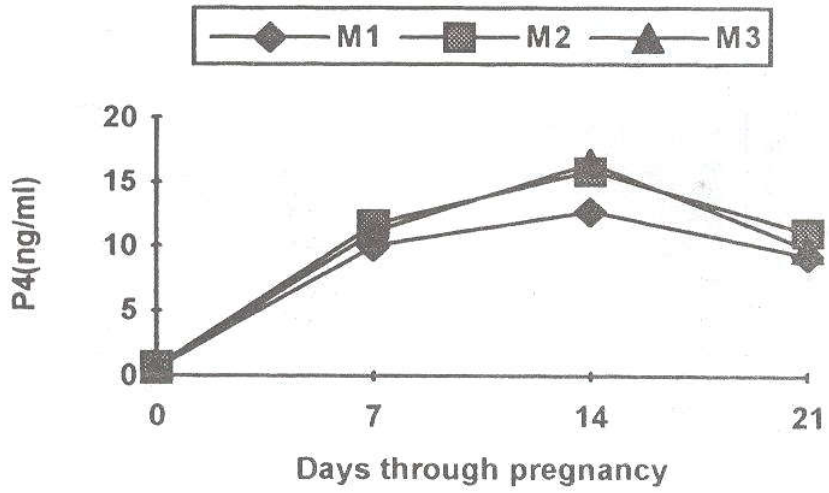

Figure 3. Effect of post-partum remating interval on plasma P4 concentration

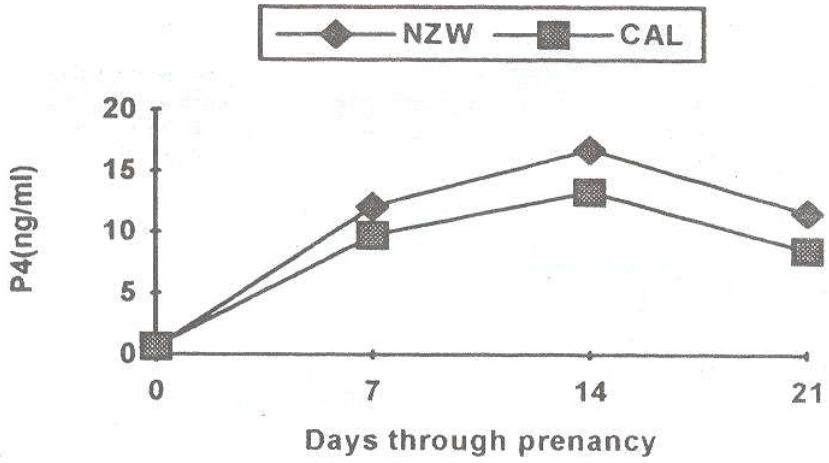

Figure 4. Plasma concentration of P4 in NewZealand and Calfornian rabbits.

Table 2. Means of gestation period (day) and No. of litters per doe in NewZealand and Calfornian rabbits under different systems of mating

Remating intervals	Breed		
	NZW	Cal.	Average
Gestation period			
1 day PP	30.6	30.4	30.5
7 days PP	30.5	30.8	30.6
28 days PP	31.8	30.3	30.6
Means	30.6	30.5	
No. of litters			
1 day PP	4.57^{ab}	5.14^{a}	4.86^{a}
7 days PP	2.57^{c}	3.86^{abc}	3.21^{b}
28 days PP	2.57^{c}	3.57^{bc}	3.07^{b}
Means	3.42^{b}	4.19^{a}	

a,b,c Means bearing different superscripts differ significantly ($P < 0.05$).
S E = 0.17 for gestation period and 0.43 for No. of litters/ doe

Productive performance data are presented inTable 3 and 4 and Fig. 4. Does mated at 28 days PP had higher single bunny weight than those mated on the 7th and the 1st day PP, respectively., Litter and bunny weights at birth increased when the period of mating PP was delayed from 1 to 7 days. This result may be attributed by smaller litter size at birth in case of postweaned mating. Litter and bunny weights at birth were higher in NZW (473.4 and 76.2g) than that of Cal. rabbits (421.5 and 55.5 g), respectively. Greater litter weight at weaning was noticed with does mated 7 days PP. At the same time mean bunny weight of does mated on the 7th or 28th day PP recorded heavier body weight at birth, weaning and at 8 weeks of age than those mated at the 1st day PP. NZW does had higher bunny weight at weaning and at 8 weeks of age than Cal. rabbits.

Averages of daily gain of NZW were higher than Cal. youngs and the highest daily body weight gain from birth to weaning was observed in bunnies of does mated 7 days PP (Table 3). However, bunnies of does mated 28 days PP showed the highest daily gain from 4 to 8 weeks of age. This result may be attributed to the low number of bunnies per litter.

Body weight of litter from 5 to 8 weeks of age for NZW and Cal. rabbits are shown in Fig. 5. Bunnies in group M_3 and M_2 maintained higher body weights after weaning than those of M_1group allover the experimental period.

Feed conversion ratio was higher in NZW youngs (4.04) than in Cal. youngs (3.80).It improved as the mating after parturition delayed in the two breeds.

DISCUSSION

The present study proved that a high rate of conception in the two breeds was observed with does mated at day one PP. This result might be due to high activity of ovaries and ready mature follicles. This result is consistent with Hafez (1970) who reported that suckling causes a reduction in the size of the ovaries and the number of their follicles, most of the large follicles which exist at kindling degenerate when lactation begins. He added that lowered pregnancy rate during periods of heavy lactation results from the regression of corpora lutea and a lowering of pituitary FSH.

which curtails follicular development. On the other hand Foxcroft and Hasnain (1973) stated that reducing fertility in the case of lactating does was possibly due to inadequate nutrition, resulting in reduced FSH stimulation of follicular development and hence also in luteal regression in does that had ovulated.

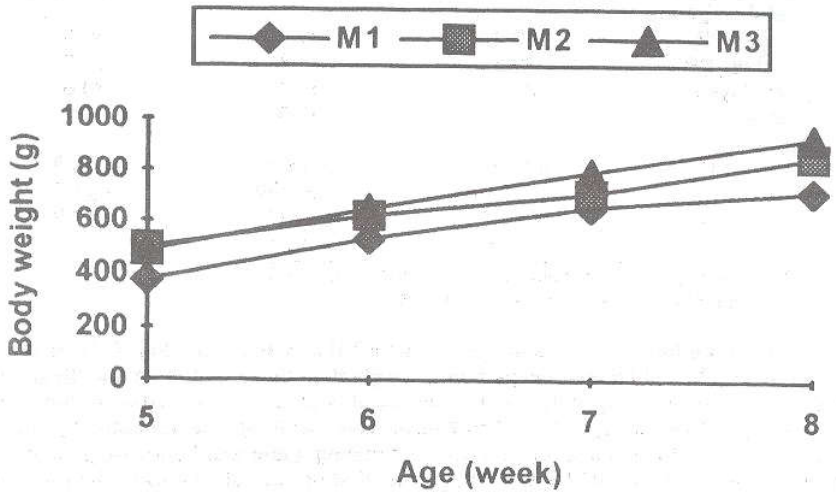

Figure 5. Effect of remating interval on post-weaning bunny weight at different ages as averages for NewZealand and Calfornian rabbits.

Table 3. Effect of remating interval and breed on performance of NewZealand and Calfornian rabbits under Egyptian conditions (within the 6 months of study).

Trait	NZW			Cal		
	M1	M2	M3	M1	M2	M3
No. of bunnies/doe at birth (3 itters)	25	18	15	25	23	21
Av. litter size at birth	8.2	6.1	5	8.3	7.7	6.9
Av. bunny weight at birth, g	64.3	73.2	88.0	50.3	55.5	60.8
Av. litter size at weaning	5.0	4.9	5.0	6.2	5	5.3
Av. bunny weight at weaning,g	325.9	412.6	359.0	278.4	387.0	362.8
Preweaning mortality(%)	50	77	64	50	73	42
Average litter size at 8 weeks	1.96	1.9	2.0	2.7	2.0	2.3
Av. bunny weight at 8 weeks,g	746.9	907.2	983.0	689.6	799.5	873.3
Litter weight at birth, g	533.7	446.5	440.0	417.5	427.4	419.5
Litter weight at weaning, g	1630	2022	1795	1726	1935	1923
Av.litter weight at 8 weeks, g	1464	1724	1966	1862	1599	2009
ADG from birth to weaning, g	9.4	12.1	9.7	8.2	11.8	10.8
ADG from 4 to 8 weeks g	15.0	17.7	22.3	14.7	14.7	18.2
Feed intake/ doe, Kg	41.5	36.8	34.7	38.5	33.9	35.2

ADG Average daily body weight gain

Table 4. Economic evaluation of different mating systems in the expenses and return of rabbit rearing

Item	Remating system, day		
	1	7	28
Marketable product (Kg) / doe	8 3	6.3	5.8
Expected meat production (Kg) /doe /year	16.5	12.6	11.6
Income from product, L.E*	132.0	100.8	92.5
Cost of feed / doe / year**	40.1	35.4	35.0
Return / doe / year (L.E)	91.9	65.7	57.0

* Recent price of Kg live weight = 8 L.E / Kg., ** Recent price of feed = 0.5 L.E / Kg.

Means of CR of NZW in the present study was almost similar to the results of Holdas *et al.*(1976) and Bujarbauah *et al.*(1989) who reported that CR of NZW was 51.5 and 55.6 %, respectively. However, C.R. of Cal. is close to the observation of Oudah (1990) who reported that C.R. of Cal. does was 66.6 %.

Oudah (1990) and Hussein (1995) found that the differences in CR due to the effect of parity in NZW and Cal. rabbits, under Egyptian conditions, were significant.

The changes in LSB caused by RI may be due to changes in the physiological set up of the doe for a complex of events especially those related to ovulation, implantation and intrauterine environment during pregnancy. These states are discussed below with the concentration of progesterone in plasma.

The present results show that there are differences in P4 (ng /ml) when females were mated at different periods. This may be due to the action of the high level of prolactin hormone in lactating rabbits which promote the function of corpora lutea for P4 secretion. This was evident, particularly, when mating was executed at 7 days PP with the maximum milk production expected to coincide with high concentration of prolactin. Coppola *et al.* (1979), Daniel *et al.* (1984) and Younglai (1986) reported that prolactin was essential for P4 secretion from corpora lutea and acted as an essential hormone in the rabbit uterine response to P4 by modulation of P4 receptor activity for maintenance of pregnancy. The high level of P4 at the 7th day of gestation which continued to the 14th day played an important role in the preparation of the uterus for implantation of the fertilized ova and inhibition of uterine contractions during the first few days of pregnancy (Bryand-Green *et al.*, 1982). In addition, Sharma (1979) declared that high P4 shut off the luteinizing hormone (LH) release from pituitary gland and prevented induced ovulation during pregnancy in rabbits. Moreover, P4 suppressed the immunological rejection of the fetuses (Daniel *et al.*, 1984). In the present study the P4 concentration (ng /ml) remained high until the 21 *st* day of pregnancy. The present data are in good agreement with the findings of Challis *et al.* (1973), Hillard *et al.* (1974), Habeeb and El-Masry (1991) and Hussein *et al.*(1995). They found that P4 output of female rabbits rapidly increased after implantation on day 7- 8 post-coitum to reach peak values between days 14 - 18 of pregnancy and thereafter remained high until the final week of gestation. The profile pattern of progesterone in relation with breed and remating interval in this study is already discussed (Ahmed *et al.*, 1994).

Concerning feed intake and feed efficiency, it is clear in Table (3) that does, in the two breeds, mated just after parturition consumed more feed, in average, due to more need for nutrients to cope with the greater biological burden of faster parities

repetition and greater number of reared suckling bunnies. Partridge *et al.* (1984) suggested such postulation.

CONCLUSION

It could be concluded that the earliest remating (on the 1*st* day PP) showed the more successful reproductive performance of the does than the cases of later rematings (on the 7*th* and the 28*th* day PP) as illustrated in the following ranking chart. The only drawback of the early remating is the low growth rate of suckling bunnies, most probably due to the exhaustion of the dams by the two coinciding bio-physiological event of suckling the born litter alongside the next pregnancy which is apt to reduce its capacity of nursing the offsprings by enough milk and /or changes in its nutrient composition. Consequently, the dam has to be reinforced by more good quality feeds balanced in energy and protein as well as the proper supply of the required minerals and vitamins. This dam litter relationship as affected by the composite condition of system of mating and nutritional status is still in need to further studies.

Ranking Chart of some reproductive and productive characteristics in relation with remating system.

Item	Remating system		
	1*st* day PP	7*th* day PP	28 *th* day PP
Conception rate	+++	++	+++
No. of services	++	++	+++
No. of litters /doe	+++	++	+
Litter size at birth	+++	++	+
Litter size at weaning	+++	+	++
Litter weight at birth	+++	++	+
Litter weight at weaning	++	+++	+++
Daily gain of litter (from 0-4 wk)	++	++	+++
Feed intake / doe	++	++	+++
Feed intake /litter (from 4-8 wk)	+	+++	++
Feed conversion	+	++	+++

+++ denotes the best performance, ++ is intermediate and + denotes the least performance.

The drop in the weight of the bunnies by early remating is compensated by the high number of bunnies per litter. On the other hand, the earliest remating results in gaining more parities within a certain period (one year for example) than the later mating thus having more offsprings for rearing and marketing. The expected economic evaluation of the three systems of remating as calculated on bases of the reproductive and productive performance proves that applying remating on the 1st day PP maximized the income in spite of the excess in feed utilization.

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تأثير فاصل التلقيح بعد الولادة على الأداء التناسلى والإنتاجى للأرانب

أمنية فوزى خضر١ - نجوى عبد الهادى أحمد٢ - أبو بكر عبد الله عزوز١

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أستخدم فى هذا البحث ٢٤ أنثى من كل من الأرانب النيوزيلاندى الأبيض والكاليفورنيا يتراوح وزنها من ٣-٤ كجم عند عمر ٨ شهور . قسمت الإناث تحت كل نوع طبقا لفاصل التلقيح بعد الولادة إلى ثلاثة مجاميع بعد البطن الأولى . لقحت الإناث بعد ١ ، ٧ ، ٢٨ يوم بعد الولادة فى المجموعة الأولى والثانية والثالثة على التوالى . سجلت بيانات التناسل والانتاج لكل أنثى فى ثلاثة بطون متتابعة (٢ ، ٣ ، ٤) . لوحظت أعلى نسبة خصب فى إناث المجموعة الأولى يليها الثالثة وأقل نسبة خصب شوهدت مع إناث المجموعة الثانية . أثر فاصل التلقيح بعد الولادة ورقم البطن تأثيرا معنويا على معدل الخصب . وأشارت النتائج إلى أن نسبة الخصب كانت أعلى فى الأرانب الكاليفورنيا عن النيوزيلاندى . لم تتأثر عدد التلقيحات اللازمة للإخصاب أو طول مدة الحمل بفاصل التلقيح بعد الولادة فى كلا النوعين . بوجه عام كان متوسط حجم الخلفة عند الميلاد أو الفطام أعلى فى الكاليفورنيا عن النيوزيلاندى وكان ذلك معنويا بالنسبة لإناث المجموعة الأولى مقارنة بالثانية والثالثة . كان تركيز هرمون البروجسترون فى بلازما الدم أعلى معنويا فى الإناث النيوزيلاندى عن الكاليفورنيا خلال فترة الحمل كما كان تركيز الهرمون أعلى فى الإناث التى تأخرت فى التلقيح بعد الولادة عن التى لقحت مبكرا بعد الولادة . لوحظت أعلى قيمة لتركيز هرمون البروجسترون عند ١٤ يوم من الحمل ثم أنخفضت حتى ٢١ يوم من الحمل . وجد أن نظام التلقيح المبكر بعد الولادة أدى إلى زيادة الناتج من اللحوم ولكن صاحبه زيادة فى إستهلاك العلف .