

# MATING FREQUENCY AND ARTIFICIAL INSEMINATION IN RABBIT USING VASECTOMIZED BUCK

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**SUMMARY :** Two experiments were conducted on 132 fertile females of New Zealand White (NZW) and Californian (Cal) rabbits.

The first experiment aimed to study the mating frequency and/or spermatozoa number effects on conception rate (CR), litter size and litter weight at birth. Six groups were designed to cover all possible combinations between 0, 1 or 2 matings of vasectomized buck (SB) and 1 or 2 matings of fertile buck. Each group consisted of 6 NZW and 6 Cal does, for a total of 72 females. The studied characteristics were insignificantly affected by groups or breeds. The overall means were 79.2 % CR, 6.5 young's per litter and 294 g litter weight at birth.

The second experiment was conducted to determine the possibility of using SB as ovulation inducer in artificially inseminated rabbit (AI). Equal numbers of 15 fertile females

of both NZW and Cal were naturally mated or artificially inseminated. Conception rate, young weight at birth, daily young weight gain until weaning and total litter weight at weaning showed insignificant differences between AI and natural mating groups. Mortality percentage of offspring until weaning averaged 8.7 % in AI group, lower ( $P < 0.05$ ) than 18.8 % in naturally mated group. Young's weight mean at weaning was 576.2 g in AI group heavier ( $P < 0.01$ ) than 485.8 g in the other group. However, litter size at birth and at weaning and litter weight at birth were in general significantly ( $P < 0.01$ ) higher in natural mating than AI group. At birth, litter size and litter weight means were 6.63 young's and 364.6 g for natural mating group, and 4.1 young's and 254.4 g for AI group. Insignificant differences were detected between NZW and Cal in all the studied characteristics.

**RESUME :** *Fréquence d'accouplement et insémination artificielle avec intervention de mâles vasectomisés.*

Deux expérimentations ont été conduites sur 132 femelles fertiles de race Néo Zélandaise Blanche (NZW) ou Californienne (CAL).

La première étude a pour but d'étudier la fréquence d'accouplement et/ou l'effet du nombre de spermatozoïdes sur le taux de fécondation (CR) la taille et le poids de la portée à la naissance. Six groupes ont été formés afin de couvrir toutes les possibilités de combinaison entre 0, 1 ou 2 accouplements avec un mâle vasectomisé (SB) et 1 ou 2 accouplements avec un mâle fertile. Chaque groupe comportait 6 NZW et 6 CAL soit au total 72 femelles. Les caractéristiques étudiées n'étaient pas affectées significativement par la race. Les moyennes globales furent 79.2 % de taux de fécondité, 6,5 lapereaux par portée et 294 g de poids de portée à la naissance/femelle.

La seconde expérimentation tend à déterminer la possibilité d'utiliser des mâles stériles (vasectomisés) pour induire l'ovulation au moment de l'insémination artificielle. Des groupes de 15 femelles fertiles de chacune des deux races

ont été naturellement accouplées ou artificiellement inséminées (IA). Le taux de conception, le poids des lapereaux à la naissance, leur gain de poids journalier individuel jusqu'au sevrage et le poids total de la portée au sevrage n'ont pas montré de différence significative entre le groupe des femelles naturellement accouplées et le groupe IA. Le pourcentage moyen de mortalité des jeunes jusqu'au sevrage (8.7 %) est plus faible dans le groupe IA que dans le groupe des femelles naturellement accouplées (18.8 % ;  $P < 0.05$ ). Le poids moyen des lapereaux au sevrage était supérieur (576.2 g) dans le groupe IA (485.8 g dans l'autre groupe). D'autre part la taille de la portée à la naissance et au sevrage et le poids de la portée à la naissance étaient significativement plus haut ( $P < 0.01$ ) dans le groupe naturellement accouplé que dans le groupe IA. A la naissance, la taille de la portée et son poids moyen dans le groupe naturellement accouplé étaient de 6.63 lapereaux et 364.6 g, et dans le groupe IA de 4.1 lapereaux et 254.4 g, respectivement. Aucune différence significative entre NZW et CAL n'a été détectée pour les caractéristiques étudiées.

## INTRODUCTION

The rabbit ovaries are almost continuously producing ova. When a doe is stimulated, usually by the actions of a male, then she ovulates (SANDFORD, 1986). Number of ova shed is a major factor effect on litter size. The sire fertility is another factor effect on litter size. In commercial field the largest litters consistent with suitable young's weight at birth as well as good growth are desirable characteristics. Some

authorities are advocating regular double mating to increase the rabbit fecundity (DIM *et al.*, 1991).

The artificial insemination (AI) has been use for its many advantages (SANDFORD, 1986 ; HAFEZ, 1987 ; TAWFEEK AND EL-GAAFARY, 1991). In Egypt, the AI application in rabbits is still limited. This is because the doe needs treatment by gonadotrophic and/or gonadotrophic releasing hormones for ova induction. Most of such hormones are imported by hard currency. Thus, the present two experiments aims to :

**Table 1 : Effect of mating frequency on conception rate and weight of NZW and Californian rabbits.**

Group	Treat- ment*	Conception rate %			Litter size mean $\pm$ SE			Litter weight mean (g) $\pm$ SE		
		NZW	Cal	Total	NZW	Cal	Total	NZW	Cal	Total
1	S0F1	66.7	83.3	75.0	6.25 $\pm$ 1.30	5.00 $\pm$ 1.6	5.71 $\pm$ 1.30	275 $\pm$ 25	267 $\pm$ 24	271 $\pm$ 25
2	S1F1	83.3	66.7	75.0	5.75 $\pm$ 2.27	5.40 $\pm$ 1.36	5.60 $\pm$ 2.41	288 $\pm$ 13	262 $\pm$ 45	273 $\pm$ 93
3	S2F1	83.3	83.3	83.3	6.40 $\pm$ 2.60	6.40 $\pm$ 1.00	6.40 $\pm$ 2.00	320 $\pm$ 98	300 $\pm$ 32	310 $\pm$ 74
<i>Total</i>	<i>F1</i>	77.8	77.8	77.8	6.10 $\pm$ 2.06	5.60 $\pm$ 1.32	5.90 $\pm$ 1.90	294 $\pm$ 84	276 $\pm$ 34	285 $\pm$ 64
4	S0F2	83.3	83.3	83.3	6.25 $\pm$ 2.20	6.50 $\pm$ 1.50	6.40 $\pm$ 1.00	313 $\pm$ 65	301 $\pm$ 35	306 $\pm$ 53
5	S1F2	83.3	66.7	75.0	6.50 $\pm$ 1.10	6.40 $\pm$ 1.20	6.40 $\pm$ 1.20	288 $\pm$ 42	290 $\pm$ 37	289 $\pm$ 39
6	S2F2	83.3	83.3	83.3	7.25 $\pm$ 1.10	6.30 $\pm$ 1.80	6.80 $\pm$ 1.60	325 $\pm$ 43	302 $\pm$ 71	313 $\pm$ 60
<i>Total</i>	<i>F2</i>	83.3	77.8	80.5	6.67 $\pm$ 1.47	6.40 $\pm$ 1.50	6.33 $\pm$ 1.57	309 $\pm$ 50	298 $\pm$ 48	303 $\pm$ 51
Overall		80.6	77.8	79.2	6.56 $\pm$ 2.17	6.04 $\pm$ 1.51	6.29 $\pm$ 1.88	302 $\pm$ 79	280 $\pm$ 57	294 $\pm$ 65

\* S0, S1 or S2 : means 0, 1 or 2 matings with a vasectomized buck ; F1 or F2 : means 1 or 2 matings with a fertile buck.

a/ study the effect of mating frequency and/or spermatozoa number on conception rate, litter size as well as litter weight,

b/ use vasectomized buck to induce ovulation in AI compared to natural mating results.

## MATERIALS AND METHODS

Two experiments were conducted in rabbit experimental station of the Agriculture Faculty, Suez Canal University in Ismailia, Egypt, from November 1992 till May 1993. The rabbits were housed in individual cages and fed and watered *ad libitum*. A balanced pelleted ration was used. The pellets composed of 16.4 % crude protein, 13.7 % crude fiber, 1.8 % crude fat and 2520 kcal. digestible energy. All rabbits were kept in one barn under the same environmental conditions. Forced matings were not used if the doe refused to accept the buck. The females were palpated to determine pregnancy 10 days after mating or AI.

### Experiment 1 :

The purpose of this trial was to clear out the effect of mating numbers and/or number of spermatozoa on conception rate and litter size to answer the question : is the number of copulation and/or spermatozoa number have effects on ovulation rate and consequently on the litter size.

A 6 x 2 factorial arrangement, consisting of 6 groups of 2 breeds subclasses, were replicated with 6 does. Before the experiment, the does were parturient once only. The six necessary groups required to cover all possible combination between 0, 1 or 2 matings of vasectomized buck (SB) and 1 or 2 matings of fertile

buck (FB) were carried out (Table 1). The two breeds used were New Zealand White (NZW) and Californian (Cal). Thus, 72 females were used (6 x 2 x 6). 10–16 days after parturition, the females were mated in the morning (8.0–10.0 p.m.) by SB within half hour, then mated by FB during the next half hour. Each FB copulated maximum 2 times daily with the same breed doe. All does were mated throughout 20 days of November 1992. Two fertile bucks of each breed were previously tested for semen quality. Whereas, semen volume was measured, spermatozoa concentration was microscopically determined using hemocytometer chamber and the percentages of advanced motility of spermatozoa were tested. The average of total motile spermatozoa per ejaculate was 77.74  $\pm$  3.73 million for the two Cal bucks and 98.31  $\pm$  2.53 million for the two NZW bucks. The females were weighed just before mating. The body weight differences among the 6 groups and between the two breeds were insignificant. The body weight averaged 3.5  $\pm$  0.28 kg and ranged from 3.05–3.70 kg.

### Experiment 2 :

The purpose of this trial was to use vasectomized buck for AI as ovulation inducer compared to natural mating results. Does were naturally mated or AI at 12-19 days *post partum* (2nd parturition), in the morning at 8–9 a.m., through February 1993. A doe was moved to SB for mating, then after 10 hours the doe was AI by about 0.5 ml of tris extender containing about 5 million motile spermatozoa of the same breed. The 10 hours interval was chosen expecting the best CR results according to CHEN *et al.* (1989). The semen was collected by artificial vagina and extended just before insemination at 37°C. The extender consisted of 2.84 g tris, 1.55 g citric acid, 0.4 g glucose, 0.1 g sigmamycin, 88 ml

**Table 2 : Natural mating and A.I. results after vasectomized males utilisation.**

Characteristics	Natural mating (control)			Artificial Insemination		
	NZW	Cal	Total	NZW	Cal	Total
Nb of does mated or inseminated	15	15	30	15	15	30
Conception rate %	80.0	73.3	76.7	86.7	80.0	83.3
Litter size <sup>c</sup>						
at birth	6.7 ± 1.64	6.50 ± 1.71	6.63 ± 1.68 <sup>a</sup>	4.2 ± 2.01	4.0 ± 2.65	4.1 ± 2.4 <sup>b</sup>
at weaning	5.08 ± 1.6	5.0 ± 1.53	5.04 ± 1.57 <sup>a</sup>	3.8 ± 1.61	3.6 ± 2.10	3.76 ± 6.19 <sup>b</sup>
Litters mortality till weaning %	14.1	23.1	18.8	7.3	10.4	8.74
Chi square result	-	-	-	-	-	*
Litter weight (g) <sup>c</sup>						
at birth	376 ± 114.5	349.2 ± 66.5	364.6 ± 93.8 <sup>a</sup>	267.2 ± 95.1	241.2 ± 143.2	254.4 ± 105.4 <sup>b</sup>
at weaning	2493 ± 731	2406 ± 675	2449 ± 705	2624 ± 718	2103 ± 881.3	2364 ± 776
Young's weight <sup>c</sup>						
at birth (g)	57.1 ± 3.36	53.7 ± 4.1	56.1 ± 3.7	63.4 ± 4.4	60.4 ± 4.5	62.1 ± 4.5
at weaning (g)	490.3 ± 27.4	481.3 ± 31.5	485.8 ± 29.1 <sup>a</sup>	620.2 ± 29	525.8 ± 32.4	576.2 ± 30.1 <sup>b</sup>
Daily weight gain (g/day)	12.4	12.2	12.3	15.9	13.3	14.7

\* Significant at  $P < 0.05$  ; a, b means in the same row bearing different letters, differ significantly at  $P < 0.01$ .

<sup>c</sup> Value are means ± standard errors.

distilled water and 12 ml egg yolk. The pH of semen extender was 6.8.

Thirty does (15 of each breed) was affected to each treatment.

#### Statistical analysis :

Differences in the proportions of does pregnant or litter size mortality were statistically analyzed by Chi square test. The remaining parameters were analyzed by general linear models according to SNEDECOR and COCHRAN (1982).

## RESULTS AND DISCUSSION

### Experiment 1 :

As Table 1 shows, the NZW breed recorded insignificantly higher values of CR (80.6 %), litter size ( $6.56 \pm 2.17$  young/litter) and litter weight ( $302 \pm 79$  g) than Cal breed values. The corresponding values for Cal averaged 77.8 % CR,  $6.04 \pm 1.5$  young/litter and  $280 \pm 57$  g litter weight at birth. These results agree with EL-MAGHAWRY *et al.* (1988), OUDAH (1990), YAMANI *et al.* (1991) and TAWFEEK and HINDAWY (1991), who did not recorded significant effect of the same breeds on litter size or litter weight at birth.

Regardless the breed effect, number of matings per doe also did no affect significantly on any of the

for natural mating group and 4.1 young and 254.4 g for AI

traits studied. Group 6 (4 matings) insignificantly gave the highest averages of litter size ( $6.8 \pm 1.6$  young) and litter weight ( $313 \pm 60$  g) as presented in Table 1. Results of the present experiment differed with that reported by DIM *et al.* in Nigeria (1990) on Dutch breed. They concluded that double mating produced the greatest number of young per litter. This variation may be due to breed effects. However SANDFORD (1986) advocated single fertile mating and his conclusion agreed with the present findings.

The double mating of FB permits more spermatozoa than single mating of the same buck. If this statement was taken in consideration, the spermatozoa number (double fertile matings) did not affect CR, litter size or litter weight (groups 4, 5 and 6 vs groups 1, 2 and 3) as shown in Table 1. The results of does fertilized with more sperm cells number were insignificantly higher than that of does fertilized with a smaller number of spermatozoa (one FB mating). These findings lead to the conclusion that with natural mating only one mating is sufficient, the ejaculate has spermatozoa enough to fertilize all the ovocytes.

### Experiment 2 :

Data presented in Table 2 showed that the average of CR by AI using SB was 83.3 %, insignificantly higher than natural mating or the control groups (76.3 %), and there was insignificant effect of breed also on CR. The other studies concerning AI reported higher insignificant CR in naturally mated does than AI group using

gonadotrophic hormones (XIE and LIU, 1983 ; BONANNO and COSTANZO, 1987 ; UZCATEQUI and JOHNSTON, 1988 ; TAWFEEK and EL-GAAFARY, 1991). The objective of the present work was to use SB only for AI application without any hormonal treatments.

Natural mating yielded significant higher litter size at birth ( $P < 0.01$ ) and at weaning than AI. The averages of litter size at birth and weaning were 4.1 and 3.76 for AI vs 6.63 and 5.04 for control, respectively. The literature dealing with litter size after AI or natural mating have the same trend. MACH *et al.* (1986), BONANO and COSTANZO (1987) and TAWFEEK and EL-GAAFARY (1991) reported significant higher litter size in natural mating than in AI. The breed effect or interaction between breed and method of mating on litter size at birth or at weaning were not significant.

The offspring mortality till weaning was significantly higher ( $P < 0.01$ ) in control (18.8 %) than in AI group (8.7 %). This may be due to the higher litters, and the lighter young's weight at birth in natural mating or, in other words, the suckling competition among the high number of offspring in natural mating group resulted to smaller growth rate (Table 2) and may induce higher mortality. TAWFEEK and EL-GAAFARY (1991) reported 25.9 % mortality for offspring in NZW naturally mated until weaning. No significant difference was observed between the two breeds in mortality of litter till weaning.

Mean of litter weight at birth in control group was 364.6 g which is significantly higher ( $P < 0.01$ ) than in AI group (254.4 g) ; however at weaning insignificant effect was detected. The average of litter weight per doe at weaning was 2449 g in natural mating group and 2364 g in AI group. The higher weight of litter at birth in naturally mated group could be attributed to the increase of litter size rather than that of young's weight (Table 2). The obtained results are in fairly agreement with those reported by AFIFI and EMARA (1984) and EL-MAGHAWRY *et al.* (1988). The litter weight at birth or at weaning are not affected significantly by breed.

The average of young's weight at birth was insignificantly heavier in AI (62.1 g) than in natural group (56.1 g). However at weaning, young's weight in AI group was 576.2 g, significantly heavier ( $P < 0.01$ ) than that of group control (485.8 g). As the litter size decrease the individual body weight of young's increase at birth ; consequently higher growth rate of the young's is expecting. Similar conclusion was stated by AFIFI *et al.* (1973), EL-MAGHAWRY *et al.* (1988), TAWFEEK and EL-GAAFARY (1991). The average daily weight gain of young's till weaning was insignificantly higher (14.7 g/day) in AI litters than in natural mating group litters (12.3 g/day). Insignificant effect was found for breed on young's weight at birth or at weaning or on young's weight gain till weaning.

In conclusion the results of the first experiment indicated that the number of matings/or spermatozoa number are not affecting on conception rate, litter size or litter weight at birth. The second experiment data showed that vasectomized buck could be used (instead of imported hormones) for AI application in rabbits. However, additional series of experiments have to be conduct, such as the suitable time of AI after mating by vasectomized buck, how many does can be stimulated by one sterile buck and economical comparison between vasectomized buck and ovulation hormones inducer on the basis of conception rate and litter size.

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