Non-genetic factors affecting rabbit production in Egypt

Yamani K.A.O., Daader A.H., Askar A.A.

in

Rouvier R. (ed.), Baselga M. (ed.).
Rabbit production and genetics in the Mediterranean area

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 17

1991
pages 159-172

Non-genetic factors affecting rabbit production in Egypt

K.A.O. YAMANI
A.H. DAADER
A. A. ASKAR
NATIONAL RABBIT PROJECT, ACADEMY OF SCIENTIFIC RESEARCH & TECHNOLOGY, FACULTY OF AGRICULTURE, ZAGAZIG UNIVERSITY, ZAGAZIG, EGYPT.

SUMMARY - The present study was carried out on the New Zealand White (NZW) rabbit breed. The effect of season, remating interval, weight of doe, parity and litter size at birth on some productive and reproductive traits were determined. Average of gestation length, stillbirths and preweaning mortality percentages were significantly higher in Spring and Summer than in Autumn and Winter while litter size at weaning, total milk yield, and litter weight increased significantly during Autumn and Winter with respect to Spring and Summer. Moreover, season showed a significant effect on milk conversion at second week of lactation. Season did not show any definite trend on milk conversion during the recorded lactation period which extended over the first two weeks. The lowest mean bunny weight was recorded during Summer while Spring season showed the highest bunny weight throughout the whole preweaning period (0 - 25 days) except at birth. The Winter season showed the highest bunny weight at birth only. The differences in mean bunny weight due to season were significant. Although the effect of season on conception rate and litter size at birth was not significant, the highest values for the two characters were observed during Winter. Remating interval showed a significant effect on conception rate, milk conversion during first week and litter daily gain in the period from 22 - 25 days and a highly significant effect on milk yield during the third week of age only. In general, the does mated 5 days postpartum recorded slightly higher litter size at birth or at weaning, higher milk yield and heavier litter weight than does mated 1 or 10 days. The does mated 5 days postpartum showed slightly lower stillbirths, preweaning mortality and mean bunny weight than the other two experimental groups. In contrast, does mated 10 days after parturition showed the highest percent of conception. Does weighing $\geq$ 4.0 kg showed higher conception rate, total milk yield, litter weight at weaning and mean bunny weight, while they recorded lower percentages of stillbirths and preweaning mortality in comparison with the does weighing $\leq$ 4.0 kg live weight. Gestation period, litter size at birth and milk conversion did not differ significantly due to parity. Litter size at weaning increased ($P \leq 0.05$) when parity increased. Parity showed a significant effect on milk yield and litter weight. Total milk yield and litter weight were lower in the 2nd parity than in the 1st one and increased gradually with the advancement of parity up to the 5th one. In contrast, bunny weight, stillbirths and preweaning mortality were significantly higher in first, second and third parities, than those produced in fourth and fifth ones. Litter size at weaning, litter weight at birth and mean bunny weight were increased significantly with increasing litter size at birth. Moreover, litters comprising 5 or 7 youngs had the lower preweaning mortality, while litters of $\geq$ 10 youngs recorded the highest values. Postnatal litter weight was higher in litters of 7, 9 or $\geq$ 10 young, while litters comprising $\leq$ 4 young had the smallest values. The effect of litter size was significant on preweaning mortality, milk yield, and postnatal litter weight, but not significant on gestation period, stillbirths, milk conversion, and litter weight at third week of age.

Key words: Rabbits, nongenetic, Egypt, production, reproduction.

RESUME - "L'influence de certains facteurs non génétiques sur la production du lapin en Egypte". La présente étude a été menée sur des lapins de race Néo-Zélandaise Blanche (NZW). Les effets de la saison, intervalle mise bas-saillie, poids de la lapine, numéro de mise bas et taille de la portée à la naissance, sur certaines caractéristiques de production et de reproduction, furent déterminés. La durée moyenne de gestation, le pourcentage de mortinatalité et de mortalité pré-

Options Méditerranéennes - Série Séminaires - n° 17 - 1991: 159-172

sevrage ont été sensiblement plus élevés au printemps et en été par rapport à l'automne et l'hiver, tandis que la taille de la portée au sevrage, la production totale de lait, et le poids de la portée, étaient significativement plus hauts en automne et en hiver par rapport au printemps et à l'été. De plus, la saison a eu une influence significative sur l'indice de transformation laitière durant la deuxième semaine de lactation. Nous n'avons remarqué aucune tendance en ce qui concerne l'indice de transformation laitière pendant la période de la lactation où des données ont été enregistrées, c'est-à-dire les deux premières semaines. La moyenne de poids des lapereaux la plus faible fut enregistrée en été cependant qu'au printemps le poids des lapereaux fut le plus élevé pour toute la période pré-sevrage (0 - 25 jours), sauf pour la naissance. L'hiver fut la saison où les lapereaux, uniquement au moment de la naissance, avaient le poids le plus élevé. Les différences de poids chez les lapereaux dues à la saison ont donc été significatives. Cependant, l'effet de la saison sur le taux de conception et la taille de la portée à la naissance n'a pas été significatif, car les valeurs les plus élevées pour ces deux caractères ont été observées en hiver. L'intervalle mise bas-saillie a eu un effet significatif sur le taux de conception, l'indice de transformation laitière pendant la première semaine, le GMQ de la portée pendant la période allant du 22ème au 25ème jour, et a eu un effet très significatif sur la production de lait pendant la troisième semaine d'âge uniquement. En général, les lapines qui étaient saillies 5 jours après la mise bas avaient des tailles de portée légèrement supérieures à la naissance ou au sevrage, une meilleure production de lait et un poids de la portée plus élevé que celles qui étaient mises à la reproduction 1 ou 10 jours après. Les lapines saillies 5 jours après la mise bas montraient un taux légèrement plus bas de mortinatalité, de mortalité pré-sevrage, et un poids des lapereaux un peu plus faible que chez les deux autres groupes expérimentaux. Par contre, les lapines saillies 10 jours après la mise bas avaient le taux de conception le plus élevé. Les lapines pesant $\geq$ 4,0 kg avaient un taux de conception, un rendement total laitier, un poids de la portée au sevrage et un poids des lapereaux moyen, plus élevés, tandis que les pourcentages de mortinatalité et de mortalité pré-sevrage étaient inférieurs par rapport aux lapines pesant $\leq$ 4,0 kg de poids vif. La période de gestation, la taille de la portée et l'indice de transformation laitière n'ont pas varié de façon significative selon la parité. La taille de la portée au sevrage a augmenté ($P \leq 0,05$) en même temps que la parité. La parité a montré un effet significatif sur le rendement en lait et le poids de la portée. Le rendement total laitier et le poids de la portée étaient plus faibles lors de la 2ème parité que lors de la 1ère, et augmentaient de façon progressive avec l'avancement de la parité jusqu'à arriver à la 5ème. Par contre, le poids des lapereaux, la mortinatalité et la mortalité pré-sevrage étaient significativement supérieurs lors des 1ère, 2ème et 3ème parités, par rapport à ceux des 4ème et 5ème parités. La taille de la portée au sevrage, le poids de la portée à la naissance, et le poids moyen des lapereaux augmentaient de façon significative lorsque la taille de la portée à la naissance était plus élevée. De plus, les portées de 5 ou 7 lapereaux présentaient la mortalité pré-sevrage la plus faible, cependant que les portées $\geq$ 10 jeunes montraient les valeurs les plus élevées. Le poids de la portée post-naissance était supérieur chez celles de 7, 9 ou $\geq$ 10 lapereaux, tandis que les portées $\leq$ 4 jeunes présentaient les valeurs les plus faibles. L'effet de la taille de la portée était significatif sur la mortalité pré-sevrage, le rendement laitier, et le poids de la portée post-natal, mais ne l'était pas en ce qui concerne la période de gestation, la mortinatalité, l'indice de transformation laitière, le poids de la portée à la troisième semaine d'âge.

***Mots-clés :** Lapins, non-génétique, Egypte, production, reproduction.*

Introduction

The New Zealand White (NZW) as a commercial meat rabbit breed was recently introduced in Egypt in order to participate in increasing meat production since it is a prolific animal, fast growing and of high fecundity. Under the Egyptian conditions, these advantages are affected to a great extent by several factors such as the environmental and management conditions. Moreover, the suitable time of mating after parturition is considered as one of the most interesting principles in the farm management of rabbits. If the remating interval (the period from kindling to remating) is reduced, it may offer the greatest opportunity for increasing the output of weaned rabbits per doe in comparison with genetic improvement to identify prolific strains. (Partridge *et al.*, 1984). The information about the effect of these factors on productive and reproductive performance of such high prolific breed are not completely available. Therefore, effect of season of kindling, remating interval, weight of doe, parity and litter size at birth on some productive and reproductive traits of NZW rabbits raised under the Egyptian environmental conditions were studied.

Materials and methods

The present study was carried out on the foundation stock of NZW rabbit breed in the National Rabbit Project, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. The does were first mated when they reached a mean body weight of 3.5 kg at 20 to 22 weeks of age. The animals were ranked according to body weight and then allocated evenly to three treatment groups to be remated either 1, 5 or 10 days postpartum over a one year of production, started in March 1987.

The does were housed in individual cages of a commercial type (59 x 55 x 39 cm) provided with feeders, automatic drinkers and nest-boxes (40 x 32 x 29 cm). The cages were stabilized into a conventional unheated windowed building. The building was naturally ventilated but provided with sided electric fans. The animal were lighted 14 - 16 hours per day throughout the experimental year. The prevailing climatic conditions throughout the period of the study are presented in Table 1. The animals were reared under similar environmental conditions. They were fed on a pelleted diet containing approximately 16.3 % crude protein, 2.5 % crude fat and 14.0 % crude fiber. The pelleted ration was provided with a premix composed of minerals and vitamins to provide rabbits with balanced nutrient requirements. Rabbits drank clean fresh water by nipple drinkers all the time.

The does were mated with NZW bucks of proven fertility. The doe was transferred to the buck's hutch at the time of service for a short period. Forced mating was performed if the doe refused to accept the buck without restraint. All does were mated twice whenever it was possible. Nest-boxes were checked every morning and the dead pups were removed.

The does were weighed at mating and postpartum. Litter weight was measured at birth and weekly up to weaning. The young rabbits were weaned after twenty five days. Milk yield of does after kindling was estimated weekly in grams up to weaning. Estimation of this trait began from birth until weaning. The youngs were deprived of suckling their mothers for 24 hours. Thereafter, the pups were weighed before and after suckling. The increase in pups weight was indicated as milk yield of doe.

Studied traits affected by the forementioned factors were conception rate, gestation period, litter size at birth and at weaning, stillbirths %, preweaning mortality %, milk yield, milk conversion, litter weight and mean bunny weights.

Statistical analysis was performed according to Snedecor and Cochran (1982). The unweighted mean procedure was followed in case of the presence of unequal subclass numbers. Tests of significance between levels of each factor were carried out using t-test. Two models of statistical analysis were used. The first model included effects of seasons, remating interval and weight of doe and all possible interactions, while the second model included effects of parity, litter size at birth and the interaction between them.

Table 1. Atmospheric temperature (C) and relative humidity % in Zagazig during the different seasons of the year.

Season		Atmospheric temperature(C)			Relative humidity %	
		Maximum	Minimum	Medium	Maximum	Minimum
	March	20.7	9.5	15.1	84.3	42.5
Spring	April	26.2	12.2	19.2	74.6	30.9
	May	32.2	25.4	23.8	70.5	26.2
	June	34.7	19.6	27.2	76.5	31.9
Summer	July	35.8	21.6	28.7	82.6	38.6
	August	34.8	22.1	28.5	86.1	44.9
	September	33.4	19.9	26.7	87.4	45.5
Autumn	October	29.1	16.6	22.9	83.4	35.3
	November	25.5	12.7	19.1	84.1	47.4
	December	20.7	11.3	16.0	84.0	54.7
Winter	January	21.0	9.4	15.2	83.9	50.0
	February	23.4	10.3	16.9	81.9	45.4
	March	21.3	9.8	15.6	83.0	46.5
	April	26.3	11.9	19.1	87.8	35.7

Source: General Organization of Meteorology (Abbasia, Cairo).

Results and Discussion

SEASON OF KINDLING EFFECT

The results concerning the effect of season on conception rate (CR), gestation period (GP), litter size at birth (LSB) and at weaning (LSW), stillbirths (SB) and preweaning mortality (PM) percentages are presented in Table 2. It is noticeable that conception rate during Winter and Spring is greater than that of Autumn and Summer, but statistical analysis of data revealed that the differences among seasons were not significant. These results agreed with the findings reported by Sittman *et al.* (1977), Masoero and Auxilia (1977) and Torres *et al.* (1977).

Averages of gestation length in both Spring and Summer differ significantly from gestation length in Autumn and Winter (Table 2). Conflicting results were found in the literature; while some authors found a significant effect of season on gestation length (Rodriguez *et al.*, 1985), other authors failed to find any significant effects (Kliment, 1974; Such *et al.*, 1978 and Ibrahim, 1985).

Means of litter size at birth in different seasons (Table 2) indicated that the highest litter size at birth was noticed during Winter. However, the effect of season on this trait was not significant. These findings are similar to those obtained by Such *et al.*, (1978) and Ibrahim (1985). On the contrary, Randi (1982) reported significant effect for season on litter size.

Means of litter size at weaning in different season varied significantly ($P \leq 0.01$) from 4.3 young at Spring to 6.4 at Winter (Table 2). This low figure at Spring could be attributed to high litter losses during the suckling period, which occurred in litters born during this season. It could be seen from these results that the highest litter size at weaning was recorded at winter. This might be due to the favourable conditions especially ambient temperature in that season. These results did not agree with Casady *et al.*, (1962) and Ibrahim (1985) who found that the litter size at weaning was not affected by season.

Data of stillbirths and preweaning mortality percentages as affected by season are presented in Table 2. The highest percentages of stillbirths and preweaning mortality were found in Spring (10.2 and 36.2, respectivily) then followed by that in Summer but the lowest percentages occurred during Autumn and Winter. The differences among seasons were significant for both stillbirth ($P \leq 0.05$) and preweaning mortality ($P \leq 0.01$). This may be attributed to a high variation in the ambient temperature among different seasons of the year, where it increased to a high level in Spring and Summer and decreased to a favourable level in Autumn and Winter. Similar findings were previously demonstrated by Rafai and Papp (1984) and Gualterio *et al.* (1988) who showed that the mortality of pups was increased with increasing ambient temperature. The present results were fairly in agreement with the findings reported by Ibrahim (1985) who stated that preweaning mortality increased in Spring with significant differences among seasons in this respect.

Means of milk yield and milk conversion in different seasons (Table 4) showed that the highest milk yield was produced during Winter in all stages of lactation except those of first week where the highest production was recorded during Autumn. Does kindling during Spring recorded the lowest milk yield. The effect of season was significant over the period of lactation. Results given in Table 3 showed no definite trend for season effect on milk conversion. However, differences in milk conversion due to season reached a significant level at the second week only. The results were in agreement with those achieved by Rafai and Papp (1984) who reported that the highest milk yield was recorded at 15 °C; an average temperature recorded during Winter season under the Egyptian environment.

The overall means of litter weight and mean bunny weight as affected by season are shown in Table 6. These results revealed that litter weight was nearly similar in Spring and Summer as well as in Autumn and Winter. Litter weight in Autumn and Winter was significantly ($P \leq 0.01$) higher than in Spring and Summer, this occurred over the period of growth from birth up to weaning (25 days of age). The differences in this character among different seasons may be attributed to the variation in the climatic conditions of these seasons. The results agreed with the findings reported by Rafai and Papp (1984) who found that daily gain of litter was higher at 15 °C than at 25, 30 or 35 °C. Moreover, Lui *et al.* (1980) stated that dry season (April - September) recorded higher litter weight either at birth or at 21 days of age than rainy season (October - March).

The average bunny weight of individuals born in Autumn excelled those born in Winter. The lowest mean bunny weight was recorded in Summer, while Spring had the highest mean at 21 days and at weaning age. Mean bunny weight at birth in Winter season recorded the highest weight. This may be attributed to the difference among seasons in mortality rate, whereas the amount of milk suckled by each young will increase with the increase of mortality rate or decreasing pups number per doe. Differences among seasons in that respect were highly significant. Ibrahim (1985) reported that mean bunny weight in Winter and Spring at 6, 12, 18 and 24 days of age was similar.

Table 2. Means ($\bar{x}$), standard errors (SE) and coefficients of variability (CV) for the effect of season of kindling, remating interval, and doe weight on conception rate, gestation length, litter size at birth, litter size at weaning, stillbirths % and preweaning mortality %.

Traits		Season of kindling				Remating interval			Doe Weight	
		Spring (56)*	Summer (38)	Autumn (39)	Winter (41)	1-Day (58)	5-Day (55)	10-Day (61)	< 4,0 (91)	$\geq$ 4,0 (83)
Conception rate%	$\bar{x}$	76.3	63.3	68.9	89.0	70.9 b	68.4 b	87.9 a	73.6	78.3
	$\bar{x}$	32.8 a	32.7 a	31.1 b	32.0 b	32.4	32.2	32.7	32.5	32.4
Gestation period	SE	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1
(days)	CV%	3.3	3.9	4.0	2.6	3.0	3.2	4.3	3.6	3.7
	$\bar{x}$	7.3	7.4	7.3	8.0	7.0	7.8	7.7	7.5	7.5
Litter size at birth	SE	0.4	0.4	0.3	0.3	0.2	0.3	0.4	0.2	0.3
	CV%	36.7	31.9	29.0	25.3	24.0	30.8	35.8	30.7	32.1
	$\bar{x}$	4.3 c	5.2 b	5.2 ab	6.4 a	5.1	5.6	5.3	5.2	5.5
Litter size at weaning	SE	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.2
	CV%	47.7	38.2	20.1	21.5	34.5	33.9	38.5	37.7	33.6
Stillbirth %	$\bar{x}$	10.2	4.1	1.3	1.0	5.1	2.8	4.1	6.7	2.0
Preweaning mortality %	$\bar{x}$	36.2 a	22.4 b	11.3 c	12.9 c	20.6	19.2	22.3	24.5	17.9

Means in the same row having the same letters did not differ significantly, otherwise they differ ($P \leq 0.05$).
* Figures given in parentheses represent the number of individuals within each subclass.

REMATING INTERVAL EFFECT

The results of the effects of remating interval on conception rate, gestation period, litter size at birth, and at weaning, stillbirths and preweaning mortality are presented in Table 2. It could be observed that the group of does which were mated 10 days after parturition showed the highest percent of conception, while 5 days remating interval gave the least conception rate. The differences in conception rate due to remating interval were significant. Similar results were obtained by Perry (1983) and Mendez *et al.* (1986). The average length of gestation period was found to be unaffected by the mating system. However, slight differences were noticed.

The present results showed that the average litter size at birth was 7.0, 7.8 and 7.7 for does which were mated 1, 5 or 10 days after kindling, respectively. The differences among groups were not significant. Also, non-significant effects for remating intervals on litter size at birth were reported by Partridge *et al.* (1984) and Szendro. (1988). On the contrary, Perry (1983) reported significant differences in litter size at birth due to remating interval.

The present results revealed that the effect of remating interval on litter size at weaning was found to be non-significant. However, does which were mated 5 days postpartum had slight increase in litter size at weaning, this might be attributable to the highest litter size at birth and to the lowest preweaning mortality rate in this group of does in relation to what was occurring in the other groups. In agreement with the present findings, previous studies elsewhere, (Martin and Donal, 1976 and Mendez *et al.*, 1986) reached the same conclusion.

Results of Table 2 showed that stillbirths and preweaning mortality were not significantly affected by remating interval. Does that were mated 5 days after kindling showed the least mortality at birth and weaning as compared to does mated 1 or 10 days after kindling. The results were fairly in agreement with those obtained by Martin and Donal (1976).

Regarding the effects of remating intervals on milk yield, it was noticed that does mated 5 days postpartum recorded higher milk yield than does mated 1 or 10 days postpartum. This result was noticed in the whole period (0 - 25 days) except in the last three days (22 - 25) where milk yield was higher in does mated 10 days postpartum. Statistical analysis of data showed that the differences in milk yield among different groups were not significant except at the third week where the differences were highly significant. However, the elevated milk yield in the 5 days remating interval may be attributed to the low kindling frequency associated with the low conception rate in this group of does.

Milk conversion of does during the first week of lactation was significant ($P \leq 0.05$), decreased for does mated 10 days postpartum as compared to does mated 5 days postpartum. Research work concerning effects of remating interval on milk yield and milk conversion is very scanty in the literature except that of Lammers *et al.* (1988) who reported that does mated 42 days after parturition recorded higher milk yield than does mated 33 days postpartum.

The results of the remating interval effects on litter weight and mean bunny weight are presented in Table 6. It could be noticed that does mated 5 days after kindling recorded higher litter weight than those mated 1 or 10 days after kindling, but the differences were not significant for all intervals except at weaning (25 days of age). This may be due to the good health and efficiency resulting from the low rate of kindling in does mated 5 days after parturition. Similar findings were reported by Kawinska and Niedzwiadek (1975). At the same time, Mendez *et al.* (1986) found that litter weight at 21 days of age averaged 2000 g in does mated immediately after kindling, corresponding to 1635 g obtained in the present study.

Values of mean body weight in does mated 1 and 10 days postpartum were similar in all stages of the suckling period, and each of these higher than that of 5 days remating interval. The differences were not statistically significant. These results agreed with Kawinska and Niedzwiadek (1975) who reported that mean offspring weight at birth for does mated 10 - 20 days after kindling was greater than that produced by does mated 4 - 7 days after kindling.

WEIGHT OF DOE EFFECT

The overall means of CR, GP, LSB, LSW, SB and PM as affected by weight of doe are presented in Table 2.

Conception rate was slightly greater for the heavier does, but the differences were statistically not significant. Gestation length was not affected by mother's weight at parturition. Litter size at birth was not significantly affected by live doe weight. Similar results are obtained by Niedzwiadek *et al.* (1983). However, Afifi *et al.* (1976 and 1980) reported that litter size at birth increased significantly with the increase of mother's weight.

There was a slight increase in litter size at weaning when weight of doe was above 4.0 kg as compared to weight below 4.0 kg, but the difference was not significant. This agrees with Afifi *et al.* (1980) who showed that litter size at weaning increased with the increase of mother's weight.

The does weighing < 4.0 kg showed no significant increase in stillbirths and preweaning mortality compared with does weighing ≥ 4.0 kg. This agrees with Attila Ballay et al. (1988).

Milk yield produced by does weighing ≥ 4.0 kg was higher than that of does weighing < 4.0 kg (Table 4). This increase was significant at second and third weeks. However, milk conversion in does weighing < 4.0 kg was, in general, similar to that of does weighing ≥ 4.0 kg through the first two weeks. These findings agree with those obtained by Cowie (1969), Abo-Elezz et al. (1981), Sekanina (1982), Lukefahr et al. (1983) and Attila Ballay et al. (1988), while Ibrahim (1985) indicated that does weighing 2.7 - < 3.0 kg recorded the highest milk yield.

The does weighing ≥ 4.0 kg had heavier litters than those weighing < 4.0 kg (Table 6). The differences in litter weight due to mother's weight were significant only in the third week and at weaning. Similar results were obtained by Afifi *et al.* (1980) and Attila Ballay *et al.* (1988). However, Ibrahim (1985) observed that litter weight at birth in Giza White rabbits increased with the increase of mother's weight, while litter weight and daily gain in weight of litter (at weekly intervals up to weaning) increased with the increase of mother's weight up to 2.7- <3.0 kg and declined thereafter. Ragab *et al.* (1952) and Wanis (1958) reported no consistent relation between mother's weight and the total weight of the pups at birth.

From these results and the previous results on milk yield it could be observed that an increase in litter weight and litter daily gain was associated with an increase in milk production, whereas the does yielding more milk had heavier litter weight and higher litter daily gain. Consequently, it is worth mentioning here that heavier litter weight and higher daily gain of litter may be due to the higher milk yield of the doe. This agrees with Lukefahr *et al.* (1981) who reported that total weight gain of litter and litter weight at 21 days of age were highly correlated with total milk yield. Holdas and Szendro (1982) found also that weight gain was highly correlated with milk yield (0.84 - 0.90).

It could be seen from results given in Table 6 that the average bunny weight of does weighing ≥ 4.0 kg excelled that of does weighing < 4.0 kg. However, the differences in means were not significant over the preweaning period. Afifi *et al.* (1980) found positive correlations between weight of doe and birth and weaning weight of pups.

Table 3. Means ($\bar{x}$), standard errors (SE) and coefficients of variability (CV) for the effect of parity and litter size at birth on gestation period, litter size at birth, litter size at weaning, stillbirths % and preweaning mortality %.

Traits		Parity						Litter size at birth						
		1st (24)*	2nd (23)	3rd (26)	4th (26)	5th (28)	6th (24)	≤ 4 (19)	5 (22)	6 (18)	7 (20)	8 (25)	9 (18)	≥ 10 (29)
Gestation period (days)	$\bar{x}$	33.0	32.9	32.7	32.4	32.4	32.3	32.9	32.9	32.9	32.4	32.6	32.3	32.4
	SE	0.3	0.2	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.2	0.2	0.3	0.2
	CV%	3.7	3.0	2.5	5.2	2.4	1.5	4.5	3.5	3.4	2.5	2.7	4.4	2.7
Litter size at birth	$\bar{x}$	6.7	7.1	7.2	7.2	7.7	7.8							
	SE	0.6	0.6	0.6	0.4	0.4	0.5							
	CV%	40.9	43.0	39.1	30.9	27.2	28.3							
Litter size at weaning	$\bar{x}$	4.0 c	3.8 c	4.9 bc	5.8 ab	5.9 a	6.0 a							
	SE	0.3	0.4	0.4	0.3	0.3	0.3							
	CV%	42.5	54.6	39.0	28.3	23.1	23.1							
Stillbirth %	$\bar{x}$	8.6 a	17.2 a	8.0 a	1.1 b	1.6 b	1.7 b	7.7	3.1	7.5	2.1	7.8	6.1	3.9
Preweaning mortality %	$\bar{x}$	35.1 b	45.4 a	24.4 c	13.9 d	11.0 d	16.1 d	25.0 b	5.2 c	22.2 b	11.9 c	27.0 b	32.0 ab	41.5 b

Means in the same row having the same letters did not differ significantly, otherwise they differ ($P \leq 0.05$).
* Figures given in parentheses represent the number of individuals within each subclass.

Parity effect

The results obtained for the effect of parity on GP, LSB, LSW, SB and PWM are presented in Table 3.

Gestation length decreased with the increase of parity, but the effects were not significant. Similarly, Niedzwiadek *et al.* (1983) found in New Zealand White rabbits that gestation length averaged 30.2, 31.5, 31.4, 31.8, 31.8 and 32.1 days for six successive parities, respectively, which seemed to change unconsiderably.

Litter size at birth was increased as parity increased (beginning from 6.7 young at first parity to 7.9 young at sixth parity). However, the differences in litter size among parities were not significant. Similar results were achieved by Hafez (1970), Kalinowski and Rudolph (1977), Ponce de Leon (1978), and Ibrahim (1985) and Khalil and Mansour (1987). On the other hand, Such et al. (1978) and El-Maghawry *et al.* (1988) reported a significant effect. Kawinska *et al.* (1979) and Niedzwiadek *et al.* (1983) reported that effect of parity on litter size at birth did not show any consistent trend. Litter size at weaning increased as parity advanced up to the 6th one. The differences in this character due to parity were significant ($P \leq 0.01$). Niedzwiadek *et al.* (1983) found similar trend. Contrary to these results, Ibrahim (1985) and El-Magawry *et al.* (1988) observed that litter size at weaning was unaffected by parity.

A high percentage of stillbirths and preweaning mortality occured during first and second parities, while they decreased relatively at the 3rd parity and reached the lowest level throughout the fourth, fifth and sixth parities. The present results were nearly in agreement with those obtained by El-Maghawry *et al.* (1988) and Gualterio *et al.* (1988). On the contrary, Kalinowski and Rudolph (1977) showed that stillbirths and preweaning mortality increased with the increase of parity. Khalil and Mansour (1987) found that parity had no significant effect on preweaning mortality.

The results presented in Table 5 showed that milk yield was lower in 2nd parity than in the 1st one but milk yield increased gradually from the 2nd parity as parity advanced up to the 5th and remained on the same level in the sixth parity. The parity had significant ($P \leq 0.01$) effect on milk yield in all stages of lactation. Milk conversion was not affected significantly by the parity. Moreover, the parities showed no definite trend in this character. The present results were nearly in agreement with those achieved by Abo-Elezz *et al.* (1981) and Holdas and Szendro (1982) who showed that milk yield increased as parity advanced. However, Reddy and Donker (1964), Hafez (1970) and Lukefahr *et al.* (1981) showed that milk yield in the 2nd lactation was higher than in 3rd lactation.

Litter weight at the second parity was lower than that of first parity (Table 7). Beginning with the second parity, this trait was increased gradually as parity advanced up till the fifth one. The results of litter weight at birth were similar in the 1st and 2nd parity but

Table 4. Means ($\bar{x}$), standard errors (SE) and coefficients of variability (CV) of weekly and total milk per doe and milk conversion as affected by season of kindling, remating interval and doe weight.

Traits			Season of kindling				Remating interval			Doe Weight	
			Spring (56)*	Summer (38)	Autumn (39)	Winter (41)	1-Day (58)	5-Day (55)	10-Day (61)	< 4,0 (91)	≥ 4,0 (83)
Milk Yield per doe (g)	1st week	$\bar{x}$	577.9 b	623.1 ab	729.4 a	689.6 a	644.8	677.7	624.4	625.9	672.4
		SE	27.2	29.2	26.6	26.6	24.7	26.9	23.7	21.7	18.6
		CV%	35.2	28.9	22.8	24.7	29.2	29.4	29.6	33.1	25.2
	2nd week	$\bar{x}$	874.9 b	905.9 b	1113.0 b	1142.7 a	977.1	1035.7	984.3	941.0 a	1060.8 b
		SE	43.6	40.9	38.0	36.6	43.0	38.2	35.2	30.6	31.6
		CV%	37.3	27.8	21.3	20.5	33.5	27.4	27.9	31.0	27.1
	3rd week	$\bar{x}$	921.6 b	992.6 b	1254.2 b	1317.0 a	1005.6 b	1163.4 a	1146.4 a	1034.0 a	11822.2 b
		SE	50.6	48.9	41.5	32.8	48.4	44.3	41.1	35.3	37.3
		CV%	41.1	30.4	20.7	15.9	36.7	28.2	28.0	32.6	30.8
	Until weaning	$\bar{x}$	341.8 c	430.7 b	500.7 c	519.0 a	427.8	437.0	468.6	415.3	477.6
		SE	20.9	24.0	20.8	18.8	22.7	19.6	18.3	15.5	17.1
		CV%	43.3	34.4	25.9	23.2	40.5	33.2	30.4	35.5	32.7
	Total yield	$\bar{x}$	2737.0 b	2952.2 b	2597.2 a	3668.4 a	3055.8	3313.8	3223.9	3016.4 a	3393.5 b
		SE	127.7	129.2	107.0	83.5	117.9	114.0	111.0	91.6	91.3
		CV%	34.9	27.0	18.6	14.6	29.4	25.5	26.9	29.0	24.5
Milk Con-version	1st week	$\bar{x}$	1.82	1.85	1.73	1.92	1.83ab	1.92 a	1.75 b	1.86	1.79
		SE	0.05	0.06	0.06	0.07	0.04	0.05	0.06	0.04	0.04
		CV%	20.10	20.20	20.90	20.20	18.40	18.00	25.30	21.10	20.40
	2nd week	$\bar{x}$	2.10 ab	2.35 a	2.16 b	2.01 b	2.01	2.10	2.26	2.12	2.14
		SE	0.07	0.09	0.09	0.04	0.08	0.05	0.06	0.05	0.06
		CV%	26.30	24.60	26.00	13.10	30.80	16.90	22.30	24.60	23.90

Means in the same row having the same letters did not differ significantly, otherwise they differ (P ≤ 0.05).
* Figures given in parentheses represent the number of individuals within each subclass.

declined in the third one and increased gradually thereafter up to the sixth parity. The differences in litter weight due to parity were significant (P ≤ 0.01) for all stages of preweaning growth. The results were nearly in agreement with those achieved by Niedzwiadek *et al.* (1983). Inversely, El-Maghawry et al. (1988) indicated that litter weight at birth increased as parity advanced up to the third one. The same authors found that litter weight at weaning increased from the first to the second parity and declined thereafter.

Results in Table 7 show that single offspring weight decreased (P ≤ 0.01) as parity advanced up to the 3rd and increased thereafter up to the 6th. This was accompanied by the smallest body weight. However, Ibrahim (1985) indicated that mean body weight increased faster in the second parity than in the first parity but this increase was non-significant. Non-significant effects were reported also by El-Maghawry *et al.* (1988). The effect of interaction between parity and litter size on mean bunny weight was significant only for litter trait at weaning.

Litter size effect

Data for effects of litter size on GP, LSW, SB and PWM are presented in Table 3. Litter size at birth did not show a significant effect on gestation length. But a significant correlation was reported by Rodriguez *et al.* (1985).

The differences in mortality rate among categories of litter size were not significant concerning stillbirths. Similar results are cited by Broeck and Lampo (1975) and El-Maghawry *et al.* (1988) who reported that mortality rate was affected by litter size at birth. In addition, they indicated that mortality rate was highest in very small litters and in very large litters. However, Rao *et al.* (1977) and Gualterio *et al.* (1988) found that litter size did not affect the preweaning mortality.

Results given in Table 5 indicated that the lowest milk yield was produced when litter size was ≤ 4 young, while the highest milk yield was recorded at litters of 7 young. Litter size showed highly significant effect on milk yield in all stages of lactation except the period from 22 - 25 days of lactation which showed a significant effect ($P \leq 0.05$).

The effect of litter size at birth on milk conversion was not significant. Similar results were cited by Hafez (1970), Holdas and Szendro (1982) and Ibrahim (1985).

Results shown in Table 7 indicated that litter weight at birth increased with the increase of litter size, but in other stages of the suckling period litter size at birth showed no definite trend for litter weight. The present results were in accordance with those of Ibrahim (1985). The differences among most litter sizes in litter weight were highly significant. El-Khishin *et al.* (1951), Johnson and Venge (1952), Wanis (1958), Afifi *et al.* (1988), Attila Ballay *et al.* (1988) and El-Maghawry *et al.* (1988) concluded that litter weight at birth and at weaning increased with the increase of litter at birth.

The present study showed that average individual bunny weight (in all stages of preweaning growth) decreased with the increase of litter size (Table 7). However, mean bunny weight at weaning (25 days of age) was similar in litters of 8 or 9 young (Table 7). In general, statistical analysis showed that litter size had a highly significant effect on mean bunny weight. Similar results were reported by El-Khishin *et al.* (1951), Johnson and Venge (1952), Wanis (1958), Broeck and Lampo (1975) and El-Maghawry *et al.* (1988). Those latter authors found that mean bunny weight for litters of $\geq$ 10 young in New Zealand rabbits averaged 50.57 g at birth versus 48.6 g in the present work.

In general, it could be concluded from results of this work that mating of does should be ceased during the hot periods of the year, otherwise heat stress on rabbits should be reduced by any available methods to continue mating programmes. The does may be mated immediately after kindling or after 10 days. Does mated 10 days after parturition showed the highest percent of conception. Other litter traits related to the remating interval had only a small range of variation. Doe weight must be equal to or above 4.0 kg during her production life, but they should not be fatty. On commercial production and for large sizes of litters (above 7 young), only 7 young may remain with the mother and the other must be transferred to another doe which kindled less than 7 young.

Table 5. Means ($\bar{x}$), standard errors (SE) and coefficients of variability (CV) of weekly and total milk yield and milk conversion as affected by parity and litter size at birth.

Traits			Parity						Litter size at birth						
			1 st (24)*	2 nd (23)	3 rd (26)	4 th (26)	5 th (28)	6 th (24)	≤4 (19)	5 (22)	6 (18)	7 (20)	8 (25)	9 (18)	≥10 (29)
Milk yield per doe (g)	1st week	X	575.5 cd	523.3 d	602.1 bcd	667.0 abd	747.0 a	697.5 ab	436.5 c	652.7 ab	565.9 b	690.1 a	687.5 a	671.6 ab	709.6 a
		SE	35.5	50.8	37.5	33.6	33.2	30.3	36.5	38.3	35.6	32.1	39.2	45.3	39.4
		CV%	30.2	46.6	31.8	25.7	23.5	21.1	36.4	27.5	26.7	20.8	28.5	28.6	29.9
	2 nd week	X	870.3 b	754.2 b	861.9 b	1027.7 a	1144.8 a	1101.6 a	683.8 c	1000.4 c	863.6 b	1061.1 a	1017.5 ab	982.0 ab	1068.1 a
		SE	52.9	63.0	56.2	44.4	46.1	36.5	50.3	59.5	55.4	59.3	54.8	63.5	50.8
		CV%	29.8	40.1	33.2	22.0	21.3	16.2	22.1	27.9	27.2	25.0	26.9	27.4	25.6
	3 rd week	X	973.6 c	696.1 e	952.9 cd	1144.7 bc	1258.2 ab	1341.8 a	811.2 c	1067.2 ab	967.2 c	1175.9 a	1049.3 ab	1109.0 ab	1218.5 a
		SE	68.5	61.7	61.5	56.9	36.7	41.0	70.2	61.5	69.9	75.4	68.6	77.2	66.9
		CV%	34.4	42.5	32.9	25.4	15.4	15.0	37.7	27.0	30.6	28.7	32.7	29.5	29.5
	Until weaning	X	375.6 b	303.3 b	364.2 b	478.0 a	500.0 a	510.7 a	334.8 c	396.5 abc	372.2 bc	473.1 a	452.9 a	430.0 ab	477.0 a
		SE	26.2	29.7	27.0	26.5	24.8	21.1	30.1	31.3	25.7	34.2	30.2	35.2	28.7
		CV%	34.2	47.0	37.9	28.3	26.3	20.2	39.2	37.0	29.3	32.3	33.3	34.7	32.4
	Total yield	X	2795.0 c	2277.3 d	2781.1 cd	3317.4 b	3649.9 ab	3651.6 a	2266.2 c	3116.8 ab	2768.9 b	3400.1 a	3207.3 a	3192.7 a	3473.5 a
		SE	167.9	181.4	162.2	143.1	110.7	103.8	176.6	161.8	159.2	168.5	172.6	198.0	167.0
		CV%	29.4	38.2	29.7	22.0	16.1	13.9	34.0	24.4	24.4	22.2	26.9	26.3	26.0
Milk conversion	1 st week	X	1.83	1.77	1.94	1.71	1.80	1.90	1.72	1.80	1.90	1.85	1.86	1.32	1.83
		SE	0.08	0.08	0.07	0.08	0.06	0.09	0.04	0.07	0.06	0.07	0.08	0.10	0.09
		CV%	21.90	21.40	18.50	23.60	16.70	24.00	24.00	18.90	13.30	17.60	20.50	23.60	26.90
	2 nd week	X	2.07	2.17	2.36	2.23	1.89	2.01	2.07	2.19	2.05	2.00	2.36	1.89	2.17
		SE	0.10	0.15	1.13	0.12	0.05	0.09	0.12	0.10	0.11	0.10	0.14	0.10	0.12
		CV%	24.00	33.10	27.40	26.70	14.00	22.10	24.70	20.90	23.70	22.10	29.30	22.60	30.40

Means in the same row having the same letters did not differ significantly, otherwise they differ ($P \leq 0.05$).
* Figures given in parentheses represent the number of individuals within each subclass.

Table 6. Means ($\bar{x}$), standard errors (SE) and coefficients of variability (CV) for the effect of season of remating interval, and doe weight on litter weight and mean bunny weight.

Traits			Season of kindling				Remating interval			Doe Weight	
			Spring (56)*	Summer (38)	Autumn (39)	Winter (41)	1-Day	5-Day (55)	10-Day (61)	< 4.0 (91)	≥4.0 (83)
Litter Wt. (g)	At birth	x	390.2 bc	346.8 c	422.9 ab	466.6 a	394.2	421.7	403.2	394.5	418.8
		SE	16.3	18.2	19.1	18.1	14.7	18.2	6.2	13.2	13.3
		CV%	31.3	32.3	28.2	24.8	28.3	32.0	31.3	32.0	29.0
	21-days	x	1481.1 b	1395.9 b	1904.2 a	1943.4 a	1635.2	1685.5	1620.7	1546.3 a	1755.3 b
		SE	64.3	71.9	55.1	50.5	64.0	64.3	62.2	47.7	53.7
		CV%	33.9	31.8	18.1	16.5	29.8	28.3	30.0	29.4	27.8
	At weaning	x	1641.2 b	1670.5 b	2298.6 a	2330.2 a	1888.1 b	2052.2 a	1937.5 ab	1849.4 a	2075.6 b
		SE	79.0	83.1	62.4	54.7	73.1	80.6	75.4	59.1	63.8
		CV%	36.0	30.7	17.0	15.0	29.5	29.1	30.4	30.5	28.0
Mean bunny Wt. (g)	At birth	x	56.5 a	48.4 b	59.7 a	60.0 a	57.4	421.7	55.6	54.6	58.1
		SE	1.8	1.6	1.8	1.7	1.5	1.9	1.5	1.3	1.4
		CV%	23.5	20.9	18.8	18.4	28.3	24.7	21.6	22.1	21.6
	21-days	x	358.8 a	277.6 c	324.2 ab	308.8 bc	324.5	306.0	332.7	313.8	330.0
		SE	15.4	15.0	9.2	8.7	10.5	10.7	14.1	9.6	10.1
		CV%	32.0	33.4	17.7	18.1	24.6	26.0	33.1	29.1	27.9
	At weaning	x	428.8 a	339.7 c	396.0 ab	376.6 bc	388.2	379.6	400.2	381.7	398.4
		SE	18.3	16.9	10.8	11.5	12.6	13.2	16.2	10.9	12.3
		CV%	32.0	30.7	17.1	19.6	24.8	25.8	31.6	27.4	28.1

Means in the same row having the same letters did not differ significantly, otherwise they differ ($P \leq 0.05$).
* Figures given in parentheses represent the number of individuals within each subclass.

Table 7. Means ($\bar{x}$) and standard errors (SE) of litter traits as affected by parity and litter size at birth.

Traits			Parity						Litter size						
			1st (24)*	2nd (23)	3rd (26)	4th (26)	5th (28)	6th (24)	< 4 (19)	5 (22)	6 (18)	7 (20)	8 (25)	9 (18)	> 10 (29)
Litter weight	At birth	$\bar{x}$	371.7 b	371.7 b	342.9 b	385.6 ab	436.3 a	448.8 a	239.7 d	303.0 c	327.2 c	405.0 b	424.2 b	456.9 b	529.1 a
		SE	20.5	30.7	19.6	25.3	21.0	25.1	11.0	15.0	15.0	15.3	17.9	21.1	19.2
	7-days	$\bar{x}$	611.5 b	547.0 b	566.3 b	737.7 a	814.9 a	762.8 a	450.1 c	662.4 ab	569.2 b	737.7 a	733.6 a	739.9 a	784.6 a
		SE	36.2	55.9	39.5	43.7	34.1	31.6	35.1	43.3	38.6	32.7	45.6	55.2	43.5
	14-days	$\bar{x}$	1009.0 c	912.0 c	926.0 c	1201.4 b	1398.3 a	1310.8 ab	780.0 b	1147.3 a	1003.7 ab	1381.0 a	1161.6 a	1234.8 a	1244.8 a
		SE	64.3	93.1	57.7	59.9	49.2	51.9	58.1	82.0	68.8	66.1	73.5	82.4	66.2
	21-days	$\bar{x}$	1453.3 bc	1213.6 c	1298.0 c	1679.5 b	1954.4 a	1918.9 a	1210.5	1607.4	1416.0	1760.1	1595.8	1687.4	1771.1
		SE	91.0	111.8	75.5	78.8	48.9	58.1	101.8	102.2	97.3	92.5	99.2	96.0	88.7
	At weaning 25-days	$\bar{x}$	1708.2 c	1383.3 c	1536.0 c	2038.0 b	2297.8 a	2336.5 a	1423.2 c	1901.4 ab	1714.8 bc	2160.9 a	1901.3 ab	2006.8 ab	2053.1 a
		SE	118.1	126.3	88.5	100.0	59.2	118.1	124.9	123.1	119.3	108.7	121.4	117.3	116.4
Litter daily gain	1st week	$\bar{x}$	46.5 bc	43.7 c	44.0 c	57.3 a	60.4 a	55.5 ab	37.0 b	53.9 a	42.7 b	53.5 a	54.3 a	54.6 a	58.9 a
		SE	3.1	4.5	2.4	3.2	2.8	3.3	2.9	3.8	2.6	2.6	3.3	4.1	3.7
	2nd week	$\bar{x}$	63.3 bc	56.0 bc	53.6 c	68.6 b	87.7 a	81.0 a	48.3 b	68.1 a	63.8 a	75.5 a	66.7 a	77.2 a	75.0 a
		SE	4.7	6.5	3.2	3.8	4.0	3.9	3.6	4.9	5.1	5.8	5.5	5.6	4.5
	3rd week	$\bar{x}$	79.5 bc	48.1 c	56.4 c	70.5 b	81.3 a	90.5 a	62.8	70.5	70.0	72.2	66.1	72.7	81.1
		SE	6.7	4.6	3.7	4.5	3.8	3.1	7.6	5.4	5.8	5.0	4.8	5.2	5.5

Continuation

Traits			Parity						Litter size						
			1st (24)*	2nd (23)	3rd (26)	4th (26)	5th (28)	6th (24)	< 4 (19)	5 (22)	6 (18)	7 (20)	8 (25)	9 (18)	> 10 (29)
	22-25 days	x̄	76.3 bc	61.2 c	65.6 c	95.5 ab	90.9 b	107.2 a	59.1	75.0	78.4	104.2	87.5	85.6	87.8
		SE	10.9	10.2	6.4	6.3	5.4	6.0	7.8	7.8	9.0	8.0	8.9	9.9	8.0
	Overall mean 0-25 days	x̄	66.8 c	52.9 d	55.3 d	72.9 bc	80.6 ab	83.2 a	52.9 b	67.4 a	64.1 ab	77.1 a	69.3 a	72.0 a	75.6 a
		SE	4.3	4.7	3.3	3.4	2.2	2.5	4.4	4.5	4.1	3.4	4.3	4.1	4.0
Mean bunny weight	At birth	x̄	56.8 ab	53.7 bc	48.3 c	53.8 bc	62.2 a	58.5 ab	66.8 a	60.6 ab	55.2 bcd	57.7 bc	53.0 cde	50.8 de	48.6 e
		SE	2.6	2.8	2.4	1.9	2.6	1.8	3.0	3.0	2.6	2.2	2.3	2.3	2.3
	7-days	x̄	137.3	132.0	115.1	122.4	131.5	124.3	168.6 a	143.1 b	125.6 bc	120.6 cd	120.1 cd	110.8 d	108.7 d
		SE	8.5	6.0	6.8	4.3	5.4	6.0	8.6	6.7	5.6	3.9	3.9	4.5	4.9
	14-days	x̄	246.1	235.0	202.1	207.7	235.0	215.5	299.8 a	250.5 b	223.6 bc	214.2 cd	205.5 cd	200.7 cd	188.1 d
		SE	15.4	13.2	14.6	8.6	8.6	8.4	16.8	11.1	8.8	9.9	10.3	7.5	8.7
	21-days	x	391.6 a	338.2 ab	289.4 b	295.3 b	331.7 b	320.3 b	461.7 a	358.3 b	335.1 bc	298.3 cd	294.0 cd	295.7 cd	277.3 d
		SE	26.0	22.5	21.6	13.7	9.3	11.7	27.5	15.8	14.2	10.3	17.2	15.2	12.8
	At weaning 25-days	x	471.9 a	412.0 ab	343.8 c	365.6 bc	395.3 b	402.8 b	569.2 a	423.5 b	416.1 bc	374.9 cd	354.2 de	356.4 de	330.8 e
		SE	29.9	27.5	23.3	16.4	10.6	16.2	22.6	17.6	16.3	12.3	17.4	19.6	15.8

Means in the same row having the same letters did not differ significantly, otherwise they differ ($P < 0.05$).
* Figures given in parentheses represent the number of individuals within each subclass.

References

ABO-ELEZZ, Z., HASSAN, A. and SAMMAK, M. (1981): Effect of litter size and mating cycles on lactation in rabbits. Alexandria Journal of Agricultural Research, 29 (1): 75-82.

AFIFI, E.A., SALAH, E., GALAL, E.S.E., EL-TAWIL, E.A. and EL-KHISHIN, S.S. (1976): Litter size at birth and at weaning in three breeds of rabbits and their crosses. Egyptian J. Anim. Prod., 16 (2): 109-119.

AFIFI, E.A., GALAL, E.S.E., EL-OKSH, H.A. and KADRY, A.K. (1980): Inter-relationships among doe's weight, litter size, litter weight and body weight at different ages in rabbits. Egyptian J. Anim. Prod., 20 (2): 127-136.

ATTILA BALLAY, A., SZOMBATH SZABO, E. and FOUP, M. (1980): Relationships between the milk production and fertility of Angora does. Proceedings of the 4th World Rabbit Congress, 10-14 October 1988, Budapest, Hungary, pp. 193-199.

BROECK, L. Van Den and LAMPO, P. (1975): The influence of non-genetic factors on rabbit breeding results. Archiv für Geflugelkund, 39 (3): 84-90. (A.B.A., 44: 2341).

CASADY, R.B., ROLLINS, W.C. and SITTMANN, D.B. (1962): Effect of season and age of dam on individual weaning weights, number weaned and total litter weight of hutch-raised domestic rabbits. Small Stock Mag., 46 (11): 7-23. (A.B.A., 31: 512).

COWIE, A.T. (1969): Variations in the yield and composition of the milk during lactation in the rabbit and the galactopoietic effect of prolactation. J. Endocr., 44: 437-450.

EL-FOULY, M.A., BORADY, A.M.A., RADWAN, A.A. and KAMAR, G.A.R. (1977): Seasonal variation in some reproductive traits of Bouscat and Giza White rabbits. Egyptian J. Anim. Prod., 17 (1): 9-19.

EL-KHISHIN, A.F., BADRELDIN, A.L., OLOUFA, M.M. and KHEIR-EL-DIN, M.A. (1951): Growth, development and litter size in two breeds of rabbits. Fac. Agric., Cairo University, Bull. No. 2.

EL-MAGHAWRY, A.M., YAMANI, K.A. and MARAI, I.F.M. (1988): A preliminary study on performance of some productive traits in New Zealand White and Californian rabbits under Egyptian environments. Proceedings of the 4th World Rabbit Congress, 10-14 October 1988, Budapest, Hungary, pp. 264-275.

GUALTERIO, L., VALENTINI, A. and BAGLIACCA, M. (1988): Effect of season and parturition order on mortality rate at birth and in the nest. Proceedings of the 4th World

Rabbit Congress, 10-14 October 1988, Budapest, Hungary, pp. 182-188.

HAFEZ, E.S.E. (1970): Reproduction and breeding techniques for laboratory animals. Lea and Febiger, Philadelphia.

HOLDAS, S. and SZENDRO, Z. (1982): Milk production of rabbits. Allatenyesztes es Takarmanyozas, 31 (2): 179-184, (A.B.A., 53: 1716).

IBRAHIM, F.A.A. (1985): Studies on some factors affecting reproductive performance, milk production and preweaning growth in rabbits. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

JOHANSON, I. and VENGE, O. (1952): A study of the variation in weight during growth and in some skeletal characteristics of adult rabbits. Lantbr. Hogskol. Ann. (Uppsala), 19, 16.

KALINOWSKI, T. and RUDOLPH, W. (1977): Reproductive performance of intensively reared rabbits. I-Litter size (Total, liveborn and weaned) in the first to sixth litters of New Zealand rabbits. Wissenschaftiche Zeitschrift der Universitat Rostock, Mathematisch Naturwissenschaftliche Reihe, 26 (1):77-80 (A.B.A., 46: 5644).

KAWINSKA, J. and NIEDZWIADEK, S. (1975): An attempt to determine optimum mating times for rabbits of the Danish White breed. Roczniki Naukowe Zooteckniki, 2 (1): 51-56., (A.B.A., 43: 5487).

KAWINSKA, J., NIEDZWIADEK, S. and TUCZYNSKA, J. (1979): The maternal ability of New Zealand White does. Roczniki Zootechniki, 6 (1): 109-115., (A.B.A.,48: 4965).

KHALIL, M.H. and MANSOUR, H. (1987): Factors affecting reproductive performance of female rabbits. J. of Applied Rabbit Research 10 (3): 140-145.

KLIMENT, J (1974): Biology of reproduction of the domestic rabbit. II. Effect of seasonal factors on fertility. Pol'nohospodarstvo, 20 (2): 123-131., A.B.A., 43: 230).

LAMMERS, H.J., PETERSON, J. and PAUW, R. (1988): Studies on the reproductive performance of female hybrid rabbits under different intensities of use. Proceedings of the 4th World Rabbit Congress, 10-14 October 1988, Budapest, Hungary, pp. 264-275.

LUI, J.F., GIANNONI, M.A.G. and BANZATTO, D.A. (1980): Effect of season on litter performance. Revista da Sociedade Brasileira de Zootecnia, 9 (4): 637-642., (A.B.A., 49: 4953).

LUKEFAHR, S.D., HOHENBOKEN, W.D., CHEEK, P.R. and PATTON, N.M. (1981): Milk production and litter growth traits in straightbred and crossbred rabbits. Journal of Applied Rabbit Research, 4 (2): 35-40, USA.

LUKEFAHR, S.D., HOHENBOKEN, W.D., CHEEK, P.R. and PATTON, N.M. (1983): Characterization of straightbred and crossbred rabbits for milk production and associative traits. J. Animal Science, 57 (5): 1100-1107.

MACH, K. and TROJAN, V. (1978): The effect of litter size on meat production of rabbits. Chovatel, 17 (7): 149-150., (A.B.A., 48: 2197).

MARTIN, S. and DONAL, R. (1976): Comparison of an intensive and a semi-intensive reproductive programme in the rabbit. 1st International Rabbit Congress, Dijon, France, 31 Mar.-2 Apr. 1976., Communications. Volume 2. France, ASFC. (1976) 6 pp.

MASOERO, G and AUXILIA, M.T. (1977): Evaluation of rabbit productivity in the course of a year. Annali dell'Instituto Sperimentale per la Zootecnia., 10 (1): 93-111., (A.B.A., 46: 6318).

MENDEZ, J., De BLAS, J.C. and FRAGA, M.J. (1986): The effect of diet and remating interval after parturition on the reproductive performance of the commercial doe rabbit. J. Animal Science, 62 (6): 1624-1634.

NIEDZWIADEK, S., KAWINSKA, J. and PALIMAKA, G. (1983): An evaluation of reproductive ability of New Zealand White female rabbits and some possibilities of using these data in selection. Roczniki Naukowe Zootechniki, 10 (1): 47-56., (A.B.A., 53: 6036).

PARTRIDGE, G.G., ALLAN, S.J., FINDLAY, M. and CORRIGALL, W. (1984): The effects of reducing the remating interval after parturition on the reproductive performance of the commercial doe rabbit. Anim. Prod., 39, 465-472.

PERRY, G.C. (1983): Productivity in relation to the parturition remate interval. Commercial Rabbit,11(3):4-5.

PONCE De LEON, R. (1978): Effect of breed on reproduction and preweaning performance in rabbits under a rotational crossbreeding system. Memoria, Asociación Latinoamericana de Producción Animal, 13: 173. (A.B.A., 47: 6355).

RAFAI, P. and PAPP, Z. (1984): Temperature requirement of (rabbit) does for optimal performance. Archiv für Experimentale Veterinärmedizin, 38 (3): 450-457.

RAGAB, M.T., ASKER, A.A. and MADKOUR, Y.H. (1952): A study of inbreeding in a flock of Egyptian rabbits. Fac. Agric., Cairo Univ., Bull. No. 97.

RANDI, E. (1982): Productivity traits in two rabbit breeds: New Zealand White and Californian. Rivista di Zootecnia e Veterinaria, 10 (2): 81-86., (A.B.A., 52: 2829).

RAO, D.R., SUNKI, G.R., JOHNSON, W.M. and CHEN, C.P. (1977): Postnatal growth of New Zealand White rabbit (*Oryctolagus cuniculus*). J. Animal Science, 44 (6): 1021-1025., (A.B.A., 45: 6778).

REDDY, R.R. and DONKER, J.D. (1964): Lactation studies. V. Effect of litter size and number of lactation upon milk yields in sprague-Dawley rats with observations on rates of gains of young in litters of various size. J. Dairy Sci., 47: 1096-1098.

RODRIGUEZ, I., SANZ, J., ALONSO, F. and ACOSTA, M. (1985): Factors affecting gestation length in rabbits. Archivos de Zootecnia, 34 (129): 183-193., (A.B.A., 54: 1243).

SEKÁNINA, A. (1982): The performance of lactating female rabbits. Chovatel, 21 (10): 225-227, (A.B.A., 35: 982).

SITTMANN, D.B., ROLLINS, W.C., SITTMANN, K. and CASADY, R.B. (1964): Seasonal variation in reproductive traits of New Zealand White rabbits. J. Reprod. Fertil., 8: 29-37.

SNEDECOR, G.W. and COCHRAN, W.G. (1982): Statistical methods. 7th ed. Ames, Iowa University, Press., USA.

SUCH, G.S., KIM, H.S., LEE, K.S. and PARK, U.I. (1978): Repeatabilities and environmental factors affecting litter size at birth and at weaning and gestation length in rabbits. Research Reports of the Office of Rural Development, Suwon, Livestock, 20: 39-43, (A.B.A., 48: 303).

SZENDRO, ZS. (1988): Investigations on frequent kindlings with a view to breeding. Proceedings of the 4th World Rabbit Congress, 10-14 October 1988, Budapest.

TORRES, S., GERARD, M. and THIBAULT, C. (1977): Fertility factors in lactating rabbits mated 24 hours and 25 days after parturition. Annales de Biologie Animale, Biochimie, Biophysique, 17 (1): 63-69, (A.B.A., 45: 3444).

WANIS, A.A. (1958): Genetical and environmental factors affecting fertility of Baladi rabbits. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.