WORLD RABBIT SCIENCE 1995, 3 (3), 119-124.

GENETIC AND NON-GENETIC FACTORS AFFECTING MILK PRODUCTION AND PREWEANING LITTER TRAITS OF NEW ZEALAND WHITE DOES UNDER EGYPTIAN CONDITIONS

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ABSTRACT : To study the genetic and non genetic factors affecting doe milk production and preweaning litter performance, 519 litters of New Zealand White rabbit were used. Sire significantly (P<0.05) affected milk yield of the first week only, while doe affected significantly (P<0.01) milk yield of most of the experimental periods except the fourth week which was insignificantly affected. Milk yield was the highest in the second parity. Season of kindling affected significantly (P<0.01) milk yield in most of the weeks of the study, except the fourth which was insignificantly affected and showed the lowest yield at summer. Litter size at birth affected significantly (P<0.01) milk yield which increased by the increase of the number of young at birth. The peak of milk production was 155.3 g/day at the third week of lactation. Sire affected insignificantly most of preweaning performances traits studied except litter size at birth (P<0.05). Doe affected significantly (P<0.01) litter size and weight at birth and weaning. Parity affected significantly (P<0.01) each of litter size and weight at weaning as well as preweaning mortality. Season of kindling affected insignificantly litter size and weight at birth and significantly (P<0.01) at weaning. Days open (from kindling to fertile mating) showed highly significant (P<0.01) effects on all preweaning litter traits studied. Each of heritability and repeatability estimates for milk yield and litter performance traits studied were, in general, low.

RÉSUMÉ : Facteurs génétiques et non génétiques affectant la production laitière et les performances des portées avant sevrage de lapines Néo-Zélandaises Blanches élevées en Egypte.
Pour étudier les facteurs génétiques et non génétiques affectant la production laitière et les performances des portées avant sevrage, 519 portées de lapines Néo-Zélandaises Blanches ont été utilisées. Le père de la portée affecte sigificativement (P<0.05) la production laitière de la seule première semaine, tandis que la mère affecte significativement (P<0.01) la production laitière de la majorité des autres semaines expérimentales exceptée la quatrième semaine qui n'est pas affectée significativement. La production laitière la plus forte est obtenue pour la deuxième portée. La saison de mise bas affecte significativement ((P<0.01) la production laitière de la plupart des semaines étudiées, à l'exception de la 4ème semaine, dont la production est la plus faible en été, mais l'écart n'est pas significatif. La taille de la portée à la naissance affecte significativement (P<0.01) la production laitière qui augmente en même temps que le nombre de jeunes nés. Le pic de la production laitière se situe en troisième semaine de lactation et atteint 155,3 g/jour. Le père affecte non significativement la plupart des performances d'avant sevrage étudiées, exceptée la taille de la portée à la naissance (P<0.05). La mère affecte significativement la taille et le poids de la portée à la naissance et au sevrage. La parité affecte significativement la taille de la portée et le poids au sevrage aussi bien que la mortalité avant sevrage. La saison de mise bas affecte non significativement la taille de la portée et le poids à la naissance, et significativement (P<0.01) le poids au sevrage. La durée de la période "μισε βασ-saillie fertile" a des effets hautement significatifs sur toutes les caractéristiques étudiées des portées avant sevrage. Les estimations d'héritabilité et de repétabilité concernant la production laitière et les performances des portées, sont en général, faibles.

INTRODUCTION

Doe milk yield and preweaning litter performance (litter size and weight) are controlled by genetic and environmental factors. In development and evaluation of breeding programs, genetic and non genetic parameters for the different productive and reproductive traits need to be evaluated accurately.

The objectives of the present study were to study the genetic and non-genetic factors affecting milk production and preweaning litter performance of New Zealand White rabbits under Egyptian conditions.

MATERIALS AND METHODS

The study was conducted in the Rabbitry Farm of the Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, using the litter of 519 New Zealand White rabbit does.

Young bucks and does were firstly mated at around 23 weeks of age. Milk yield was estimated every day by the difference in doe weight before and after suckling that occurred once every day. Each doe was transferred to buck's cage to be mated, then after returned to its cage. Mating times were at the start of the breeding season, then on the third day of kindling. Abdomen palpation was employed ten days after service for pregnancy diagnosis and the empty does were rebred by the same buck till pregnancy was achieved. Air temperature averages were 15.33, 24.78, 31.34 and 22.8°C during winter, spring, summer and autumn respectively, while their corresponding relative humidity values were 81.81, 69.96, 76.39 and 76.79 % respectively, inside the building.

A commercial pelleted diet was fed *ad libitum*. Diet used contained 16.3 % crude protein, 2.5 % fat, 14.0 % crude fibre and 2480 Kcal digestible energy/kg diet. Water was available all time by nipple drinkers.

Traits studied were weekly milk yield, litter size at birth (LSB), at 21 days (LS21) and at weaning at 28 days (LSW), litter weight at birth (LWB) and at weaning (LWW), daily average youngs gain during lactation (DYG) and preweaning mortality (MO).

Data were analysed using the Mixed Model Least Squares and Maximum Likelihood (LSMLMW) Computer program of Harvy (1990). Data of milk yield traits were analysed using the following Model 1 :

$$Y_{ijklmn} = U + S_i + D_{ij} + P_k + SE_l + C_m + e_{ijklmn}$$

where :

Y_{ijklmn} = observed value of a given dependent variable,
U = Overall mean
S_i = random effect of the i^{th} sire of doe,
D_{ij} = random effect of j^{th} doe within i^{th} sire,
P_k = fixed effect of the k^{th} parity (k = 1, 2...6)
SE_l = fixed effect of l^{th} season of kindling (l = 1, 2...4),
C_m = fixed effect of th m^{th} litter size at birth classes (<3, 4, 5, 6, 7, 8 and 9).
e_{ijklmn} = the random error.

Data of preweaning litter performance were analysed using the following Model 2 :

$$Y_{ijklmn} = U + S_i + D_{ij} + P_k + SE_l + b(X-x) + E_{ijklmn}$$

where :

Y_{ijklmn}, U, S_i, D_{ij}, P_k, SE_l and E_{ijklmn} = as in previous Model 1,
b = partial linear regression coefficients of Y_{ijklmn} on days open (interval from kindling to conception),
X = value of days open
x = overall average of days open

Paternal half-sib heritabilities for the different traits were calculated. Repeatability was computed by the LSMLMW Computer program of Harvey (1990).

RESULTS AND DISCUSSION

Milk yield

Least squares analysis of variance (Table 1) showed that sire affected significantly (P<0.05) milk production at first and fourth weeks (P<0.01), similar to that observed by EL-MAGHAWRY *et al.* (1993). Doe within sire showed highly significant (P<0.01) effect on milk production at most of the experimental periods, except at the fourth week where the effect was not significant. EL-MAGHAWRY *et al.* (1993) found that the significant differences due to doe:sire effects were detected only at the fourth week of lactation, while KHALIL *et al.* (1993) found that doe effects were detected in milk yield at 21 day and total milk yield, in New Zealand White does.

Milk production, in general, was the highest in the second parity (Table 2). However, ABO EL-EZZ *et al.*, (1981), MCNITT and LUKEFAHR (1990) and EL-MAGHAWRY *et al.* (1993) claimed that milk production increased as parity advanced.

Table 1 : Least squares analysis of variance for milk yield in New Zealand White rabbits

S.O.V.	Df	*Mean Squares* 1st week	2nd week	3rd week	4th week	Total
Sire	24	2587.48*	3073.87	3578.31	7740.54**	1224.61
Doe:Sire	99	1356.28**	2155.30**	2592.48**	898.11	1028.20**
Parity	5	2277.11*	7930.22**	6259.64**	10696.23**	3053.48**
Season	3	7177.02**	7664.49**	7444.92**	2054.72	5131.06**
Litter size at birth	6	20423.06**	26686.17**	31043.87**	11122.93**	20819.63**
Remainder	381	916.74	1428.57	1778.31	980.95	657.32

** : P<0.01 ; * : P<0.05

Table 2 : Least squares means (g/day) and their standard errors of milk yield as affected by parity, season, kindling an litter size at birth for New Zealand White rabbits, under Egyptian conditions.

Factors	*Weeks of Suckling* First	Second	Third	Fourth	Total lactation
Parity :					
1st	101.79 ± 5.12	139.11 ± 6.13	156.47 ± 6.77	82.43 ± 4.97	120.04 ± 4.07
2nd	104.48 ± 4.79	134.92 ± 5.69	164.41 ± 6.28	85.87 ± 4.60	122.62 ± 3.77
3rd	99.41 ± 4.28	124.91 ± 5.01	155.38 ± 5.52	81.67 ± 4.02	115.57 ± 3.30
4th	98.67 ± 4.61	105.30 ± 5.45	136.48 ± 6.02	79.82 ± 4.40	105.25 ± 3.61
5th	92.77 ± 5.52	108.73 ± 6.64	126.20 ± 7.35	71.70 ± 5.41	100.04 ± 4.43
6st	73.18 ± 7.46	81.22 ± 9.13	122.86 ± 9.15	65.34 ± 7.50	85.76 ± 6.14
Season :					
Winter	106.28 ± 4.29	122.24 ± 5.03	151.28 ± 5.54	83.51 ± 4.04	115.97 ± 3.31
Spring	102.24 ± 4.07	127.02 ± 4.74	154.91 ± 5.21	80.83 ± 3.79	116.36 ± 3.11
Summer	85.55 ± 5.46	113.87 ± 6.57	133.04 ± 7.23	67.99 ± 5.34	100.31 ± 4.38
Autumn	86.12 ± 5.21	99.66 ± 6.24	135.30 ± 6.91	78.90 ± 5.07	100.21 ± 4.15
Litter size at birth :					
<3	57.57 ± 6.32	77.65 ± 7.68	104.74 ± 8.51	51.00 ± 6.28	72.94 ± 5.14
4	74.41 ± 5.10	89.37 ± 6.09	108.91 ± 6.73	61.71 ± 4.94	83.75 ± 4.05
5	93.18 ± 4.69	108.15 ± 5.56	139.03 ± 6.14	77.70 ± 4.49	104.65 ± 3.68
6	92.43 ± 4.15	116.70 ± 4.38	141.76 ± 5.32	79.23 ± 3.88	107.70 ± 3.18
7	107.85 ± 4.58	121.48 ± 5.42	154.43 ± 5.97	85.18 ± 4.37	117.38 ± 3.58
8	109.73 ± 5.11	139.86 ± 6.11	177.81 ± 6.75	84.57 ± 4.96	128.16 ± 4.06
>9	130.21 ± 4.86	156.67 ± 5.78	179.76 ± 6.39	105.24 ± 4.68	142.90 ± 3.83

Season of kindling affected significantly (P<0.01) milk production during most of the weeks of the study, except during the fourth one where the effect was not significant (Table 3). Milk production was higher in winter and spring than in the other seasons. The present results were in agreement with those obtained by EL-MAGHAWRY *et al.* (1993). and KHALIL (1993).

Litter size at birth was the most important non-genetic factor affecting milk yield. The milk production increased significantly (P<0.01) with the increase on the number of youngs at birth (Table 1 and 2). Similar results were reported by EL-MAGHAWRY *et al.* (1993).

Average milk yield during the whole period of the study increased till it reached the peak (155.3 g/day) at the third week. The milk yield mean value was 118.28 g/day during the whole suckling period. The obtained results were considerably lower than the 166 and 250-300 g/day obtained in New Zealand White does by SANCHEZ *et al.* (1985) and MCNITT and LUKEFAHR (1990). However, EL-MAGHAWRY *et al.* (1993). found that the milk production peak was 172.9 g/day at the second week for NZW doe, under Egyptian conditions.

Preweaning litter performances :

Analysis of variance showed that sire insignificantly affected most of preweaning

Table 3 : Least squares analysis of variance for preweaning litter performance in New Zealand White rabbits

S.O.V.	Df	*Means squares* *Litter size* Birth	21days	Weaning	*Litter weight* Birth	Weaning	Average Young gain	Litter Mortality
Sire	24	12.56*	7.06	6.52	34319.42	1096351.66	5.34	463.73
Doe:Sire	99	7.40	4.44	4.69**	24550.21**	770926.14**	4.17	461.09
Parity	5	2.10	6.87	7.57*	2095.70	1421988.63*	4.41	2075.07**
Season	3	6.15	12.26**	10.08*	19565.39	2314992.31**	2.95	681.77
Linear regression on days open	1	32.97**	40.16**	31.80**	99232.07**	5009820.29**	4.54	340.82
Remainder	386	3.58	2.34	3.29	12603.77	527627.89	3.63	394.86

** : P<0.01 ; * : P<0.05

Table 4 : Least squares means and their standard errors of preweaning performance as affected by parity and season of kindling for New Zealand White rabbits under Egyptian conditions.

	No	*Litter size*			*Litter weight*		Average young gain	Litter mortality
		Birth	21 days	Weaning	Birth	Weaning		
Parity :								
1st	123	6.61 ± 0.33	5.37 ± 0.29	5.23 ± 0.29	417.6 ± 18.6	2404.6 ± 116.5	14.5 ± 0.3	19.5 ± 3.0
2nd	124	6.35 ± 0.31	4.95 ± 0.28	4.84 ± 0.27	424.2 ± 17.6	2260.6 ± 109.2	14.5 ± 0.3	21.9 ± 2.8
3rd	103	6.41 ± 0.28	4.60 ± 0.24	4.46 ± 0.23	413.0 ± 15.3	2074.7 ± 94.0	14.9 ± 0.2	30.2 ± 2.4
4th	86	6.46 ± 0.29	4.47 ± 0.26	4.42 ± 0.25	418.6 ± 16.5	2004.5 ± 102.0	14.4 ± 0.3	31.8 ± 2.6
5th	56	6.27 ± 0.35	3.96 ± 0.32	3.88 ± 0.31	412.6 ± 20.1	1804.4 ± 126.2	14.9 ± 0.3	37.6 ± 3.3
6st	27	6.93 ± 0.47	3.82 ± 0.44	3.50 ± 0.43	429.0 ± 27.4	1624.0 ± 174.1	15.1 ± 0.5	50.9 ± 4.7
Season								
Winter	131	6.82 ± 0.27	4.92 ± 0.24	4.77 ± 0.23	437.8 ± 15.3	2184 ± 94.1	14.8 ± 0.2	29.4 ± 2.4
Spring	153	6.71 ± 0.26	4.87 ± 0.22	4.69 ± 0.22	429.4 ± 14.5	2200.6 ± 88.1	14.9 ± 0.2	29.0 ± 2.2
Summer	63	6.06 ± 0.34	3.94 ± 0.31	3.87 ± 0.31	394.3 ± 19.7	1824.7 ± 123.3	14.9 ± 0.3	35.8 ± 3.2
Autumn	172	6.43 ± 0.34	4.38 ± 0.30	4.23 ± 0.30	415.1 ± 19.2	1901.6 ± 120.0	14.3 ± 0.3	33.8 ± 3.1

performance traits studied, except on litter size at birth ($P<0.05$) . These results were in agreement with those reported by KHALIL (1993). On the other hand, doe within sire showed highly significant ($P<0.01$) effects on litter size and weight at birth and at weaning (Table 3), indicating the presence of an important maternal and dominance effects (non additive genetic effects). JOHANSSON and VENGE (1953) observed that the body size in rabbit does did not seem to be strictly additive.

Parity affected significantly each of litter size and weight at weaning ($P<0.05$) and preweaning mortality ($P<0.01$). Khalil (1993) reported that parity effect was significant on litter traits at birth, while litter traits measured during the suckling period (litter size, weight and average young gain) were not significantly affected. The insignificant effect of parity on litter size at birth and 21th day (Table 3 and 4) were similar to that reported by LUKEFAHR *et al.* (1983a) and KHALIL *et al.* (1987). Litter size at 21th day ($P<0.05$) and at weaning ($P<0.01$) decreased gradually with advancement of parity. The same trend was observed in litter weight at weaning ($P<0.05$). On the other hand, preweaning litter mortality increased significantly ($P<0.01$), while daily average young gain did not differ significantly with advancement in parity (Tables 3 and 4).

Season of kindling affected litter size and weight insignificantly at birth and significantly ($P<0.01$) at weaning. Generally, litter size values at birth and weaning were higher in winter and lower in summer than in the other seasons (Table 4). AFFI *et al.* (1977) and PATIAL *et al.* (1991) reported that season had highly significant ($P<0.01$) effect on litter size at birth and weaning, while BROECK and LAMBO (1975) and LUKEFAHR *et al.* (1983 a,b) have shown that season of kindling affected insignificantly litter size at weaning. Differences in litter size relating to season of kindling may be due to differences in environmental and nutritional conditions and mothering ability. Litter weight at weaning was low ($P<0.01$) during summer season (Tables 3 and 4), probably due to the rise of temperature during this season.

Days open showed highly significant ($P<0.01$) effects on all preweaning litter traits studied, similar to that reported by LAMMERS *et al.* (1988) and KHALIL (1993). This was contrary to that reported by SZENDRÖ (1988) and YAMANI *et al.*(1991) who found insignificant differences due to length of postpartum interval.

Genetic estimates

Heritability estimates for milk yield ranged between 0.088 and 0.217 at the different stages of suckling with the highest value at the first week (0.217). EL-MAGHAWRY *et al.* (1993) reported that the heritability estimates were 0.09–0.26 for milk production traits for New Zealand White rabbits, while PATRAS (1985) recorded the value was 0.31 for milk production. The low magnitude of heritability estimates in the present study suggest that the maternal effects and non-genetic factors represented the major source of variation in the studied traits. Estimates of heritability and repeatability for milk yield and litter performance are presented in Table 5. Heritability estimates based on paternal half-sibs ranged between 0.089 and 0.196 for litter size, and 0.097 and 0.104 for litter weight. PANELLA *et al.* (1992) recorded lower estimates heritability for litter size at birth and weaning (0.02) and higher values (0.569) for litter weight at weaning. FERRAZ *et al.* (1992) reported that heritability estimates ranged between 0.054 and 0.139 for litter size and between 0.043 and 0.199 for litter weight.

Repeatability estimates were lower for all traits studied (Table 5), similar to that reported by GARCIA *et al.* (1982 a,b), LUKEFAHR *et al* (1983), BASELGA *et*

Table 5 : Estimates of heritability and repeatability of milk yield and preweaning litter performance in New Zealand White rabbits

	Heritability	Repeatability
Milk yield :		
1st week	0.22 ± 0.13	0.25 ± 0.05
2nd week	0.10 ± 0.01	0.13 ± 0.04
3rd week	0.09 ± 0.09	0.13 ± 0.06
4th week	0.15 ± 0.11	0.16 ± 0.04
Total	0.04 ± 0.08	0.13 ± 0.04
Litter size at :		
Birth	0.20 ± 0.12	0.25 ± 0.05
21 days	0.13 ± 0.13	0.15 ± 0.04
Weaning	0.09 ± 0.09	0.12 ± 0.04
Litter weight at :		
Birth	0.10 ± 0.09	0.21 ± 0.06
Weaning	0.10 ± 0.09	0.12 ± 0.05
Litter gain	0.06 ± 0.08	0.06 ± 0.02

al. (1992) and KHALIL (1993). The low estimates of repeatability suggest that selection for production traits based on a single production record could not be undertaken for improvement of the productive potential of rabbit does.

Received : November 2, 1994
Accepted : May 12, 1995

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