ESTIMATES OF GENETIC AND PHENOTYPIC PARAMETERS FOR WEANING AND PREWEANING BODY WEIGHTS AND GAIN IN BOUSCAT AND GIZA WHITE RABBITS

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ABSTRACT

Data on 1149 young Bouscat and Giza White rabbits were analysed to estimate genetic and phenotypic parameters for body weights at birth (WB), 21 days (W21) and at weaning (WW) and preweaning daily gain (PDG). Data represent 15 sires and 67 dams. Body weights and gain at weaning showed higher variation than those at birth. Effects of year of birth on weights and gain were not significant while litter size and month of birth exerted significant effects (P<0.001) on these traits. Individual preweaning weights and gain decreased (P<0.001) as litter size at birth increased while an increase in litter weight at birth was associated with an increase in weight and gain of the young. Weights and gain tended to increase as parity advanced from the 1st to the 3rd, and to decrease thereafter. Dam affected (P<0.001) all traits studied. Sires of Giza White rabbits did not contribute significantly to the variance of traits studied while a considerable additive genetic variance (due to sire) in WW and PDG in Bouscat rabbits was observed. A reverse trend was detected for the dam component of variance (i.e. higher variance of milking and maternal abilities in Giza White dams than in Bouscat dams). This offers to the possibility for the rabbit breeders in Egypt to select the sires from Bouscat rabbits and the dams from Giza White rabbits for stratified systems of commercial production. High estimates of heritability from sire component of variance for WW and PDG (0.48 and 0.50, respectively) in Bouscat rabbits were obtained. Heritabilities estimated from littermate components (sire + dam) of variance, estimates ranged from 0.33 to 0.74, indicating the possibility to improve preweaning body weights and gain through littermate selection. Genetic (from littermate components) and phenotypic correlations (from sire and littermate components) between weights and gain at all ages studied were positive and generally of moderate or high mangnitude, and tended to decrease in value as the interval between the two ages increased.

INTRODUCTION

Preweaning body weight is an economically important trait requiring particular attention in any breeding scheme aiming at improving the overall productivity of rabbit breeds, since it is a reflection of some maternal factors and one of such factors is the doe's milking ability. Several investigators (e.g. Venge, 1963; El-Amin, 1974; Afifi et al., 1985) have reported on size inheritance in rabbits and indicated that preweaning growth is influenced by different non-genetic factors, e.g. month of kindling, parity, litter size and dam's milk supply. The study of such different factors affecting preweaning growth is useful in planning selection and breeding programmes to maximize the efficiency of growth during that period.

Information on the genetic and phenotypic analysis of preweaning growth in rabbits are scarce (McReynolds, 1974; Lampo and Broeck, 1975; Valderrama de Diaz and Varela-Alvarez, 1975; Niedzwiadek, 1978). Therefore, the objective of the present study was to quantify genetic and phenotypic variation and covariation of preweaning body weights and gain (as a reflection of the milking ability of dams) in Bouscat and Giza White rabbits.

MATERIALS AND METHODS

Data on weaning and preweaning body weights and gain of Bouscat and Giza White rabbits were collected from the Experimental Farm of the Faculty of Agriculture at Moshtohor, Zagazig University, Egypt over a period of two years (from October 1977 to September 1979). Genetic and phenotypic analyses of these traits were carried out on 1149 young produced by 15 sires mated to 67 dams. Only sires mated with a least two dams were included in the analyses.

Groups of does to be mated to one buck of the same breed were chosen at random avoiding full sisters and half sisters (paternal or maternal). Does that failed to conceive were returned to the same mating buck to be remated and were returned to the same buck every other day thereafter until a service was observed. Other details of the breeding plan and management of the experimental rabbitry were presented by Khalil et al. (1987a).

Data of individual body weight at birth (WB), 21-days (W21) as indicator for peak lactation and at weaning at 35 days (WW) and preweaning daily gain (PDG) were analysed within breed using Harvey's (1987) mixed model computer program. The following mixed model was adopted:

$$Y_{ijklmnp} = \mu+S_i+D_{ij}+A_k+B_l+C_m+D_n+b_L(X_{ijklmnp}-\bar{X}) +b_Q(X_{ijklmnp}-\bar{X})^2+ e_{kjklmnp}$$

Where $Y_{ijklmnp}$ denotes the observation on the ijklmnp rabbit, μ = the overall mean, S_i = the random effect of ith sire, B_{ij} = the ramdom effect of jth dam nested within the random effect of ith sire, A_k = the fixed effect of kth year of kindling, B_l = the fixed effect of the lth month of kindling, C_m = the fixed effect of the mth parity, D_n = the fixed effect of the nth litter size at birth, b_L&b_Q = the linear and quadratic partial regression coefficients of the observation of ijklmnpth young on its litter weight at birth, $\bar{X}$ = the mean of $X_{ijklmnp}$, and $e_{ijklmnp}$ = a random deviation of pth young of ijth dam and assumed to be independently randomly distributed (O, σ^2e). The limited numbers of records or their absence in some subclasses, did not permit the inclusions of all possible interactions. Henderson's method 3 was utilized to estimate the genetic and phenotypic variance and covariance components for the different traits. Accodingly, estimates of sire (σ^2s), dams within sire ($\sigma^2_{D:S}$) and remainder (σ^2e) components of variance and covariance were obtained. Estimates of heritability and genetic and phenotypic correlations for different body weights and gain were obtained by computing techniques described by LSMLMW program of Harvey (1987). Heritability was estimated by the expression of $4\sigma^2_s/(\sigma^2_s+\sigma^2_{D:S}\ \sigma^2_e)$ and $2(\sigma^2_s+\sigma^2_{D:S})/(\sigma^2_s+\sigma^2_{D:S}+\sigma^2_e)$ for components of paternal half-sibs and littermates, respectively. Standard errors for heritability estimates were computed according to the method described by Swiger et al. (1964).

RESULTS AND DISCUSSION

Means and Variation:

Least-squares means, standard errors and coefficients of variation (CV) of individual body weight and preweaning daily gain in the Bouscat and Giza White rabbits are given in Table 1. Means of WB and/or WW and PDG in the Bouscat and Giza White rabbits reported here were generally within the range of estimates reported by most Egyptian investigators (EL-Khishin et al., 1951; Ragab et al., 1952; Ragab and Wanis, 1960; Ghany et al., 1961; Mostageer et al., 1970; Afifi et al., 1985 & 1987). The evidence from the differences between the estimates of preweaning body weights and gain reported herein and those reported by other Egyptian

Table 1. Least-squares means (g), standard errors (SE) and coefficients of variation (CV%) of preweaning weights and daily gain in Bouscat and Giza White rabbits+

Trait	Bauscat			Giza White		
	N	Mean±SE	CV%++	N	Mean±SE	CV%++
WB	617	58± 0.7	13.5	532	58± 0.7	10.8
W21	52[illegible]	222± 7.4	20.6	431	205± 7.0	20.4
WW	463	434±19.3	18.8	351	408±16.9	19.1
PDG	463	11± 0.5	21.3	351	10± 0.5	22.0

+ Differences between two breeds for all traits were not significant ($p>0.05$).

++ Cofficients of variation computed as the remainder standard deviation divided by the overall least-squares means of a given trait (Harvey, 1987).

workers for the same and/or different breeds of rabbits could possibly be attributed to one or more of the following reasons: (1) rearing rabbits under different climatic, nutritional and managerial conditions, (2) genetic differences in growth potential and in systems of breeding, (3) different statistical models used.

Body weights (in both breeds) at later stage of the preweaning period (i.e. W21 and WW) showed higher CV's than WB, i.e. CV increased with advance of age of the young rabbit. Similarly, Afifi et al. (1985), reported higher CV's for later preweaning weights than at birth (15% at birth vs. 23% at 21 days of age). The same findings were also observed by other studies (e.g. Lukefahr, 1982). This higher CV's is likely to be due to variation in maternal effects on the offspring (lactation). The young up to the age of 12 days (when they open their eyes) remained solely dependent on their mothers' milk and therefore, until they were weaned, the mothers' milk provided the main supply of nutrients (May and Simpson, 1975). In addition, the great variation in losses of bunnies that occurred during the suckling period could be added as another source of variation in this respect.

Year of birth:

The effect of year was non-significant for all traits studied (Table 2). Nonsignificant effect for year of birth was reported by Afifi et al. (1987), while a significant effect on WB and/or W21 and WW was reported by other investigators (e.g. Ragab and Wanis, 1960; McReynolds, 1974; Afifi et al., 1982). Khalil et al. (1987b), reported that year-of-birth effects on rabbit body weights could be attributed to the usual annual changes in climatic, managerial feeding and disease conditions as well as in the stockman's skill in caring for the rabbitry.

Month of birth:

F ratios given in Table 2 shows that month of birth was one of the most important non-genetic factors influencing preweaning body weights and gain. They also indicate that the magnitude of these effects increased as age of the rabbit advanced. Most of the Egyptian studies showed that month-of-birth effects were of some importance in influencing ($P<0.01$) preweaning body weights of rabbits (e.g. Ragab and Wanis, 1960; Afifi et al., 1985 & 1987). Rabbits born during February and March had the highest ($P<0.01$) preweaning weights and gain while those born during October and November had the lowest (Tables 3 & 4). A similar trend was observed by most of the Egyptian investigators (Ragab and Wanis,

Table 2. F-ratios of least-squares analysis of variance for preweaning weights and gain of Bouscat and Giza White rabbits

Source of variation	WB				W21				WW				PDG			
	Bouscat		Giza White		Bouscat		Giza Whit		Bouscat		Giza White		Bouscat		Giza White	
	d.f.	F	d.f.	F	d.f.	F	d.f.	F	d.f.	F	d.f.	F	d.f.	F	d.f.	F
Sire*	7	0.4	6	1.5	7	1.2	6	0.6	7	3.0**	6	0.6	7	3.1**	6	0.6
Dams:sire	30	3.3***	23	1.9**	30	4.4***	23	5.9***	30	4.4***	23	4.4***	30	4.4***	23	4.4***
Year of birth	1	0.0	1	0.3	1	0.0	1	0.0	1	0.8	1	0.0	1	0.8	1	0.0
Month of birth	5	5.0***	5	3.4**	5	21.2***	5	17.1***	5	30.7***	5	22.5***	5	31.6***	5	22.5***
Parity	5	2.6*	5	2.9**	5	1.2	5	1.1	5	1.0	5	5.1***	5	1.0	5	5.1***
Birth litter size	5	55.7***	5	44.4***	5	29.6***	5	7.9***	5	20.7***	5	11.8***	5	17.5***	5	10.2***
Regression on:																
Birth litter weight, Linear	1	117.3***	1	152.4***	1	0.2	1	0.2	1	1.8	1	0.9	1	5.9**	1	0.1
Birth litter weight, Quadratic	1	0.2	1	7.5**	1	25.7***	1	2.6*	1	12.7***	1	4.0*	1	13.6***	1	5.1*
Remainder d.f.	560		483		469		382		406		302		406		302	
Remainder mean square		61		39		2083		1759		6647		6081		5.2		4.9

*Sire effect tested against dams within sire and other effects tested against remainder mean squares.
*=p<0.05; **=p<0.01; ***=p<0.001.

1960; Afifi et al., (1985 & 1987). These observations could be explained on the basis of the amount and nutritive value of the available greens and of temperature during these months. During October and November, green fodder for the pregnant and suckling does is not available in adequate quantity and is of lesser nutritive value, while during February and March, the fodder becomes more abundant and of higher nutritive value and weather conditions become milder (optimum temepraiure for rabbits production is 22°C, May and Simpson, 1975). These conditions can exert their effects on the weights and gain of the rabbit during the suckling period through the amount of milk produced by the suckling dam and on the later preweaning period from 21 days of age up to weaning through the quantity and quality of the directly ingested food, the appetite and food utilization by the young during this period.

Parity:

Preweaning body weights and gain increased with advance of parity from the 1st to the 3rd and decreased thereafter (Tables 3 & 4). Similar trend was observed by other Egyptian studies (Afifi et al., 1982 & 1985 & 1987). McReynolds (1974) observed an increase in 21-day weight with advance of parity. However, the pattern of change ($P<0.05$ or $P<0.01$) observed in birth weight due to parity effects may be due to changes in the physiological efficiency of the dam, especially those associated with nourishment and intrautrine environment provided during pregnancy which occur with advance of parity (Afifi et al., 1987). Significant changes ($P<0.01$) in WW and PDG of Giza White rabbits due to parity effect are mostly a reflection of the maternal effect, especially those associated with the sustained ability of the dam to suckle her young until weaning. Holdas and Szendro (1982) have also confirmed that milk yield of dams increased as parity advanced. Khalil et al. (1987a&b) reported that mothering ability improves with advance of parity up to the 6th, then remains constant for a period and decreases thereafter due to aging.

Birth litter size:

Preweaning body weights and gain decreased ($P<0.01$) with the increase of litter size at birth (Tables 3 & 4). The F ratios presented in Table 2 reveal that the magnitude of birth-litter size effect on preweaning body weights decreased as age of the rabbit advanced. These trends were evident in different Egyptian (El-Khishin et al., 1951; Ragab and Wanis, 1960; Afifi et al., 1973 & 1985 & 1987) and foreign (Venge, 1963; Valderrama de Diaz and Varela-Alvarez, 1975) studies on different breeds of rabbits.

Table 3. Least-squares means (grams) and standerd errors (SE) of factors affecting body weight at birth and 21 days of age.

Independent variable	WB				W21			
	Bouscat		Giza White		Bouscat		Giza White	
	N	Mean±SE	N	Mean±SE	N	Mean±SE	N	Mean±SE
Year of birth								
1977/78	420	59±1.5	361	59±1.3	357	225±11	303	207±17
1978/79	197	59±1.6	171	58±1.7	169	224±12	128	206±19
Month of birth								
Oct.-Nov.	131	55±2.4	96	53±1.7	108	144±17	87	143±16
December	43	54±2.3	45	55±2.2	39	209±16	36	206±19
January	70	60±1.7	79	60±1.4	65	217±12	67	196±14
February	109	63±1.5	87	57±1.3	99	269±11	76	241±14
March	53	56±2.3	54	62±1.7	43	259±16	51	217±16
April-May	211	63±2.4	171	62±1.7	172	249±7	114	238±16
Parity								
1st	55	60±4.9	56	60±3.3	47	212±35	47	215±27
2nd	99	64±3.2	76	64±2.2	82	224±22	64	223±19
3rd	118	67±1.7	111	65±1.5	99	230±12	82	225±14
4th	153	56±1.7	122	57±1.3	131	215±12	107	192±13
5th	111	52±3.1	89	52±2.2	97	215±22	70	196±20
>6th	81	53±4.8	79	50±3.3	70	212±34	61	188±27
Birth litter size								
≤4	52	83±2.5	47	80±2.2	48	292±16	42	263±20
5	83	69±1.8	65	68±1.6	71	245±12	53	236±15
6	90	64±1.7	89	62±1.3	76	258±12	80	195±13
7	144	54±1.6	119	53±1.2	121	246±11	101	222±13
8	104	46±1.7	72	48±1.5	96	184±12	59	164±15
≥9	144	35±2.0	140	40±1.5	114	123±13	96	159±15

Table 4. Least-squars means (grams) and standerd errors (SE) of factors affecting weaning weight and preweaning daily gain.

Indepedent variable	WW: Bouscat N	WW: Bouscat Mean±SE	WW: Giza White N	WW: Giza White Mean±SE	PDG: Bouscat N	PDG: Bouscat Mean±SE	PDG: Giza White N	PDG: Giza White Mean±SE
Year of birth								
1977/78	323	456±38	245	406±31	323	11.3±1.1	245	9.9±0.9
1978/79	140	417±34	106	410±36	140	10.2±1.0	106	10.0±1.0
Month of birth								
Oct.-Nov.	95	307±40	69	304±30	95	7.1±1.1	69	7.1±0.8
December	30	373±40	31	414±39	30	9.0±1.1	31	10.3±1.1
January	59	472±33	57	411±26	59	11.8±0.9	57	10.0±0.7
February	94	512±31	63	497±26	94	12.8±0.9	63	12.5±0.7
March	41	530±39	46	430±30	41	13.6±1.1	46	10.6±0.8
April-May	144	425±41	85	389±29	144	10.4±1.1	85	9.3±0.8
Parity								
1st	41	401±71	40	365±53	41	10.6±2.0	40	8.5±1.5
2nd	69	460±49	53	348±37	69	11.4±1.4	53	8.6±1.0
3rd	89	464±33	60	451±28	89	11.0±0.9	60	11.1±0.7
4th	110	406±34	89	409±25	110	10.0±0.9	89	10.0±0.7
5th	90	408±49	60	459±38	90	10.1±1.4	60	11.6±1.1
≥6th	64	398±69	49	413±52	64	9.7±1.9	49	10.3±1.4
Birth Litter Size								
≤4	45	531±38	36	566±40	45	12.9±1.1	36	13.9±1.1
5	66	447±33	46	477±29	66	10.8±0.9	46	11.6±0.8
6	64	503±33	66	393±26	64	12.5±0.9	66	9.5±0.7
7	106	479±32	82	437±24	106	12.1±0.9	82	11.0±0.7
8	87	371±32	45	317±30	87	9.2±0.9	45	7.7±0.8
≥9	95	286±35	76	256±30	95	7.1±1.0	76	6.1±0.8

Also, results of Mgheni et al. (1982) revealed a general pattern indicating that body weight at weaning was lower for those in large-sized litters than for those of small- and intermediate-sized litters. This inverse relationship could be attributed to that each dam has a limited capacity for providing her young with nourishment during pre-and post-natal growth until weaning and accordingly the share of each young decreases resulting in lighter weights and less gains (Afifi et al., 1985; Khalil et al., 1987b). In practice, the observed relationship, obtained in the present and reviewed studies, between body weights and litter size may be useful in any selection programme directed towards improving preweaning growth in rabbits.

Birth litter weight:

Estimates of lienar and quadratic regression coefficients given in Table 5 reveal that the increase in litter weight at birth was generally associated with the increase in body weight of the young. Such association gradually decreases as the age of the young advanced. These results, coupled with those of the effect of litter size at birth on body weight and gain (Table 2), confirm that the litter weight, as a maternal character, is decreasingly associated with the rabbit's body weight as age increases, until finally the non-maternal environmental influences become the main determining factor in this respect.

From linear and quadratic regression coefficients given in Table 5, prediction equations for preweaning body weight and gain (adjusted for other effects in the model) in Bouscat and Giza White rabbits were calculated. Therefore, a prediction curve based on the regression of preweaning body weights and gain (adjusted for other effects in the model) could be plotted to indicate the changes that would be expected in such traits with increasing litter weight at birth.

Components of Variance and heritability estimates:

Effects of sire on preweaning body weights and gain were not significant, with the exception of WW and PDG traits in Bouscat rabbits (Table 2). Results of McReynolds (1974), Lampo and Broeck (1975) and Blasco et al. (1983) indicated that differences in prewaning body weight and/or gain due to sire effect were not significant while others (Bogdan, 1970; Valderrama de diaz and Varela-Alvarez, 1975; Niedzwiadek, 1978; Khalil et al., 1987b) reported a significant effect. It is clear that there was a considerable additive genetic variance in WW and PDG traits in Bouscat rabbits (estimates of V% given in Table 6 are 12.0 and 12.5, respectively).

Table 5. Linear and quadratic regression coefficients and prediction equation of preweaning body weights and daily gain (g) on litter weight at birth (g).

Trait	Regession on litter weight at birth: Linear (gm/gm)	Quadratic (gm/gm²)	Prediction equation*
WB			
Bouscat	0.1078 ± 0.0080	-0.00002 ± 0.00004	$WB=58.9+0.1078(LWB-\bar{X})-0.00002(LWB-\bar{X})^2$
Giza White	0.1136 ± 0.0092	-0.00010 ± 0.00004	$WB=58.0+0.1136(LWB-\bar{X})-0.00010(LWB-\bar{X})^2$
W21			
Bauscat	0.0222 ± 0.0509	0.00135 ± 0.00026	$W21=222+0.0222(LWB-\bar{X})+0.00135(LWB-\bar{X})^2$
Giza White	0.0282 ± 0.0725	0.00049 ± 0.00030	$W21=205+0.0282(LWB-\bar{X})+0.00049(LWB-\bar{X})^2$
WW			
Bouscat	0.1282 ± 0.0957	0.00181 ± 0.00051	$WW=434+0.1282(LWB-\bar{X})+0.00181(LWB-\bar{X})^2$
Giza White	0.1540 ± 0.1604	0.00147 ± 0.00074	$WW=408+0.1540(LWB-\bar{X})+0.00147(LWB-\bar{X})^2$
PDG			
Bouscat	0.0065 ± 0.0027	0.00005 ± 0.00001	$PDG=10.7+0.0065(LWB-\bar{X})+0.00005(LWB-\bar{X})^2$
Giza White	0.0014 ± 0.0045	0.00005 ± 0.00002	$PDG=10.0+0.0014(LWB-\bar{X})+0.00005(LWB-\bar{X})^2$

*Where LWB= observed litter weight at birth and $\bar{X}$= mean of litter weight at birth.

A significant dam effect (P<0.01 or P<0.001) on preweaning body weights and gain was observed (Table 2). Similarly, there were dam effects (P<0.01) on preweaning body weights reported by many reviewed studies (Mostageer et al., 1970; El-Amin, 1974; McReynolds, 1974; Blasco et al., 1983; Mgheni et al., 1982; Khalil et al., 1987b) working on different breeds of rabbits. However, the expected influence of the dams on their offspring weights is due not only to genes transmitted (i.e. additive genetic effect) but also to the large maternal environmental effects in the pre- and post-natal period (i.e. due to differences in intrauterine environment and in milking and mothering ability of dams). Mgheni et al. (1982) reported that, although maternal effects decreased in relative importance after birth, they were still present at weaning and could complicate any conclusions drawn, particularly in selection experiments for preweaning growth in rabbits.

The proportion of variance attributable to the sire and dams within sire components for all traits studied are given in Table 6. Such proportion of variance attributable to Giza White dams are, in general, somewhat higher than the corresponding estimates attributable to Bouscat dams, i.e. a higher variance of milking and maternal abilities in Giza White dams than in Bouscat dams. A reverse trend was observed for the sire component. Therefore, selection of the sires from Bouscat rabbits and the dams from Giza White could be effective in a stratification system for commercial production. The presence of negative sire variance components for some weights and gain (WB in Bouscat rabbits and W21, WW and PDG in Giza White) and the small values observed for others suggest unreliable estimates of sire component of variance for these traits (Table 6). This may be due to the small numbers of sires or non-randomness in the distribution of the small numbers of dams within sire groups. Mgheni et al. (1982) reported that large maternal effects during preweaning period in rabbits may be masked the direct genetic expression of the young.

Heritability estimated within breed from the sire (h^2_S) and littermate (h^2_{S+D}) components are shown in Table 6. Estimates of heritability (h^2_S & h^2_{S+D}) for body weights and gain in Bouscat are, in general, substantially higher than the corresponding estimates in Giza White rabbits. In practice, these high estimates of h^2_S indicate the possibility for rabbit breeders in Egypt to improve WW and PDG of Bouscat rabbits through selection, while estimates of h^2_{S+D} indicate that improvement of preweaning growth in both breeds would be possible through littermates selection.

Table 6. Variance component estimates (σ^2)and proportions of variation (V%) attributable to the sire and littermate component and heritability estimates (h^2) for preweaning weights and gain in Bauscat and Giza White rabbits.

Trait	Sire σ^2_s	Sire V%	Dams:sire $\sigma^2_{D.s}$	Dams:sire V%	Remainder σ^2_e	Remainder V%	$h^2_s \pm SE$	$h^2_{s+D} \pm SE$
Bauscat:								
WB	a	0.0	11.8	16.2	61.0	83.8	a	0.33±0.09
W21	5.5	0.2	695.3	25.0	2083.4	74.8	0.01±0.04	0.50±0.12
WW	1260.0	12.0	2622.0	24.9	6647.0	63.1	0.48±0.24	0.73±0.14
PDG	1.0	12.5	2.0	24.6	5.2	62.9	0.50±0.25	0.74±0.14
Giza White								
WB	0.6	1.3	2.7	6.5	38.7	92.1	0.05±0.06	0.16±0.07
W21	a	0.0	872.0	33.1	1759.0	66.9	a	0.66±0.15
WW	a	0.0	2656.0	30.4	6081.0	69.6	a	0.61±0.15
PDG	a	0.0	2.1	30.6	4.9	69.4	a	0.61±0.15

[a] Negative estimate of variance component set to zero.

Estimates of h^2_S for body weights and gain obtained in the present study are in agreement with findings of the other studies (Mostageer et al., 1970; Zotova and Bogdanov, 1972; El-Amin, 1974; McReynolds, 1974; Lampo and Broeck, 1975; Blasco et al., 1983) while they were lower than those estimates reported by others (Bogdan, 1970; Varela-Alvarez et al. 1974). The estimates of h^2_{S+D} for preweaning body weights and gain being increased with advance of rabbit's age (Table 6). Similar estimates were obtained by Mostageer et al., (1970). These results confirm that maternal effects on body weight and gain tend to be very high at birth, decreasing thereafter gradually during the preweaning period and up to later ages.

Genetic and phenotypic correlations:

The genetic and phenotypic correlations (i.e. r_S & r_{S+D}) between different body weights and gain for both breeds showed that all of these relationships were positive (Table 7). Also, these estimates tended to decrease in value as the interval between the two ages increased. Similar findings were reported by other investigators (e.g., Valderrama de Diaz and Varela-Alvarez, 1975; Blasco et al., 1983). Estimates of genetic correlation (r_S & r_{S+D}) between body weights and gain in Bouscat rabbits were higher than the phenotypic while the reverse was observed for Giza White rabbits (Table 7). Findings of Valderrama de Diaz and Varela-Alvarez (1975) with Criollo rabbits and Niedzwiadek (1978), with New Zealand White rabbits reported similar higher estimates of genetic correlation than the phenotypic ones. Such higher or upward bias in estimates of genetic correlation than phenotypic in Bouscat rabbits may be arise from selection, i.e. survival rate from birth to weaning in Bouscat rabbits were higher than those of Giza White rabbits as reported by Khalil et al. (1987a).

Estimates of correlation based on paternal half-sibs (r_S) between PDG and WW in Bouscat rabbits were high in magnitude (Table 7) and indicate that selection at earlier ages may be effective to improve the weaning weight of Bouscat rabbits. Also, estimates of correlation based on littermates (r_{S+D}) for both breeds were positive and of moderate or high magnitude. These results may be due to their part/whole relationship. However, these estimates agree quite well with those estimates reported by other investigators (Mostageer et al., 1970; Valderrama de Biaz and VarelaAlvarez, 1975; Khalil et al., 1987b). From estimates of genetic corelation (r_S+D) together with heritability estimates (Table 6), it could be safely concluded that bunny weight at 21 days of age (age at peak of lactation) could be used to improve weaning weight at 35 days of age through indirect selection, i.e. through selection for littermate performance of body weight and gain at birth and/or 21 days of age.

Table 7. Gentic (r_G) and phenotypic (r_P) correlations for preweaning body weights and gain in Bauscat and Giza White rabbits.

Traits correlated	Sire r_G	Sire r_P	Littermate r_G	Littermate r_P
Bauscat:				
WB&W21	a	0.37	0.41	0.37
WB&WW	a	0.31	0.34	0.31
WB&PDG	a	0.24	0.30	0.24
W21&WW	0.67	0.77	0.82	0.77
W21&PDG	0.69	0.76	0.81	0.76
WW&PDG	1.01	0.99	0.99	0.99
Giza White:				
WB&W21	a	0.22	0.29	0.22
WB&WW	a	0.18	0.24	0.18
WB&PDG	a	0.12	0.21	0.12
W21&WW	a	0.70	0.65	0.70
W21&PDG	a	0.69	0.64	0.69
WW&PDG	a	0.93	0.79	0.93

[a] Negative estimate of variance component set to zero.

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REFERENCES

Afifi, E.A.; El-Tawil, E.A.; Galal, E.S.E. and El-Khishin, S.S. (1973): Some aspects of production in three breeds of rabbits and their crosses. I. Average individual eight per litter at birth. Annals of Agric. Sci., Fac. of Agric., Ain Shams Univ., Egypt, Vol. 18, No. 2.

Afifi, E.A.; Galal, E.S.E. and Kadry, A.E.H. (1982): The effect of breed and some environmental factors on litter traits in rabbits. 7th International conference for Statistics, Computer Science, Social and Demographic Research. March 1982, Ain Shams University, Cairo, Egypt.

Afifi, E.A.; Kadry, A.E.H. and Khalil, M.H. (1985): Factors influencing preweaning body weight in rabbits. Al-Azhar J. Agric. Res., 3: 101-108.

Afifi, E.A.; Emara, M.E. and Kadry, A.E.H. (1987): Birth weight in purebred and crossbred rabbits. J. Applied Rabbit Research, 10(3): 133-137.

Blasco, A.; Baselga, M. and Garcia, F. (1983): Analysis of productive characters in meat production rabbits. I. Growth characters. Archivos de Zootecnia, 32(123): 1-18.

Bogdan, S.D. (1970): The heritability of live weight in rabbits. Chuvash. Sel. Khoz. Inst., No. 1: 57-61. (A.B.A., 40, Abstr. No. 853).

El-Amin, F.M. (1974): A selection experiment for improvement of weight gains and feed conversion efficiency in rabbits. Ph.D. Dissertation, Bristol Univ., England.

El-Khishin, A.F.; Badreldin, A.L.; Oloufa, M.M. and Kheireldin, M.A. (1951): Growth development and litter size in two breeds of rabbits. Bull. No. 2, Fac. of Agric., Cairo Univ., Egypt.

Ghany, M.A.; Badreldin, A.L.; Shafie, M.M. and Hanafi, M. (1961): Some factors affecting body weight in Giza rabbits. J. Anim. Prod., Egyptian, 1: 121-134.

Harvey, W.R. (1987): User's Guide for LSMLMW. Mixed model least-squares and maximum likelihood computer program. PC-1 version. Ohio State University, Columbus, USA.

Holdas, S. and Szendro, Z. (1982): Milk production of rabbits. Hungarian Agricultural Review, 32: 95.

Khalil, M.H.; Owen, J.B. and Afifi, E.A. (1987a): A genetic analysis of litter traits in Bouscat and Giza White rabbits. Anim. Prod., 45: 123-134.

Khalil, M.H.; Afifi, E.A. and Owen, J.B. (1987b): A genetic analysis of body weight traits in young Bauscat and Giza White rabbits. Anim. Prod., 45: 135-144.

Lampo, P. and Van den Broeck, L. (1975): Der Einflub der Erblichkeit einiger Zuchtparameter beim Kaninchen und die Korrelationen Zwischen diesen parametern. Archiv fur Geflugelkunde, 39(6): 208-211.

Lukefahr, S. (1982): Evaluation of rabbit breeds and crosses for overall commercial productivity. Ph.D. Thesis, Oregon state university, corvallis, USA.

May, D. and Simpson, K.B. (1975): Reproduction in the rabbit. Anim. Breed. Abstr., 43(6): 253-261 (Article).

McReynolds, W.E. (1974): Genetic parameters of early growth in a population of New Zealand White rabbits. Ph.D. dissertation, Ohio state University, USA.

Mgheni, M.; Christensen, K. and Kyomo, M.L. (1982): Selection experiment on growth and litter size in rabbits. I- Effect of litter size on growth. Tropical Animal production, 7: 217-225.

Mostageer, A.; Ghany, M.A. and Darwish, H.I. (1970): Genetic and phenotypic parameters for the improvement of body weight in Giza rabbits. J. Anim. Prod., Egyptian, 10(1): 65-72.

Niedzwiadek, S. (1978): The evaluation of slaughter value and its application in the selection of rabbits. Krakow, Inst. Zoot., Poland, 48 pp.

Ragab, M.T. and Wanis, A.A. (1960): Factors affecting birth weight and weaning weight in the Baladi rabbits. Bulletin No. 220, Fac. of Agric., Cairo University, Egypt.

Ragab, M.T.; Asker, A.A. and Madkour, Y.H. (1952): A study of inbreeding in a flock of Egyptian rabbits. Bulletin No., 97, Fac. of Agric., Cario University, Egypt.

Swiger, L.A.; Harvey, W.R.; Everson, D.O. and Gregory, K.E. (1964): The variance of intraclass correlation involving groups with one observation. Biometrics, 20: 818-826.

Valderrama De Diaz, G. and Varela-Alvarez, H. (1975): Genetic study on the improvement of some production characters in rabbits. Agrociencia No. 12, pp. 115-124.

Varela-Alvarez, H.; Valderrama De Diaz, G. and Gomez De Varela, A. (1974): Certain genetic parameters of weights in rabbits. J. Anim. Sci., 39: 151-152. (Abstr. 64).

Venge, O. (1963): Relationships between litter size, birth weight, and growth in rabbits. Lantbrukshogskolans Annaler, 29: 221-239.

Zotova, V.S. and Bagdanov, L.V. (1972): Progeny testing of sires and heritability of live weight at a rabbit farm. Bel. Nauch. Ski. Inst. Zhivot., 13: 162-165. (A.B.A., 41, Abstr. No. 5517).

المقاييس الوراثية والمظهرية لتحسين أوزان الجسم ومعدل الزيادة اليومية خلال مرحلة ماقبل الفطام لأرانب البوسكات والجيزة الأبيض

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تم تحليل بيانات ١١٤٩ سجل لصغار أرانب البوسكات والجيزة الأبيض المولودة لعدد ١٥ أب و ٦٧ أما وذلك لتقدير المقاييس الوراثية والمظهرية لأوزان الجسم عند أعمار مختلفة من الميلاد وحتى الفطام وكذلك معدل الزيادة اليومية خلال هذه الفترة .

وتتلخص أهم النتائج لهذه الدراسة فيما يلى :-

١) أظهرت صفات وزن الجسم عند الفطام ومعدل الزيادة اليومية تباينا أعلى من صفة وزن الجسم عند الميلاد .

٢) كان تأثير سنة الميلاد على أوزان الجسم ومعدل الزيادة اليومية تأثيرا غير معنويا بينما أظهرت أشهر الولادة وعدد الصغار المولودة تأثيرا ملموسا ومعنويا .

٣) تناقصت أوزان الجسم ومعدل الزيادة اليومية بزيادة عدد الصغار المولودة بينما صاحبت زيادة اجمالى وزن الولدة فى البطن عند الميلاد زيادة فى تلك الصفات .

٤) مالت الأوزان ومعدل الزيادة اليومى للازدياد المعنوى مع تقدم ترتيب البطن للأم وذلك حتى البطن الثالثة ثم تناقصت بعد ذلك .

٥) أظهرت الأمهات تأثيرا واضحا ومعنويا لجميع الأوزان المدروسة .

٦) لم تساهم آباء نتاج أرانب الجيزة الأبيض فى تباين الصفات المدروسة بينما لوحظ أثر واضح لآباء نتاج أرانب البوسكات على أوزان الفطام ومعدل الزيادة اليومى لصغار تلك السلالة ، وعلى عكس من ذلك ساهمت أمهات نتاج أرانب الجيزة الأبيض فى تباين الصفات المدروسة وذلك بقدر أكبر من أمهام أرانب البوسكات (أى بمعنى آخر وجود تباين وراثى كبير لانتاج اللبن والمقدرة الأمية لأمهات الجيزة الأبيض وذلك مقارنة بالأمهات البوسكات) . ويعطى هذا بعض الضوء لمربى الأرانب فى مصر الى امكانية انتخاب الآباء من سلالة البوسكات وخلطها مع اناث منتخبة من سلالة الجيزة الأبيض لدارى اللحم تجاريا .

٧) تم الحصول على قيم عالية للمكافىء الوراثى المحسوب من المكون الأبوى للتباين لوزن الفطام ومعدل الزيادة اليومى (٤٨ر٠ ، ٥٠ر٠ على الترتيب) لسلالة البوسكات .

٨) تراوحت قيم المكافىء الوراثى المحسوب من المكون الأبوى والأمى معا بين ٣٣ر٠ الى ٧٤ر٠ ، حيث أشارت تلك القيم العالية الى امكانية التحسين الوراثى لصفات وزن الجسم ومعدل الزيادة اليومى فيما قبل الفطام وذلك بالانتخاب المباشر طبقا لآداء النتاج فى البطن الواحدة لتلك الصفات .

٩) كانت معاملات الارتباط الوراثى والمظهرى بين صفات أوزان الجسم ومعدل الزيادة اليومى موجبة وذات قيم متوسطة أو عالية حيث مالت تلك القيم للتناقص كلما كبرت الفروق بين الأعمار المختلفة .