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Abdel-Ghany, A. M., Ahmed E. G., Hassan, N. S.

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CROSSBREEDING GENETIC PARAMETERS OF POST WEANING GROWTH TRAITS OF THE EGYPTIAN ACCLIMATISED NEW ZEALAND WHITE AND NATIVE BALADI BLACK RABBITS

Abdel-Ghany, A. M. *; Ahmed E. G. * and Hassan, N. S. **

* Animal Production Dept., Faculty of Agriculture, Suez Canal University, Ismailia, Egypt.
** Rabbit and Turkey Breeding Dept., Animal Production Research Institute, Cairo, Egypt.

ABSTRACT

Data of the present study were obtained on a total of 650 F_1 straight-bred (367) and cross-bred (283) weaned rabbits, produced from two breeds, one exotic, New-Zealand White (NZW) and the other is an Egyptian, Baladi-Black (BB) as well as their reciprocal crosses. The study aimed at the evaluation of the direct heterotic effect of biweekly progeny growth (i.e. body weight, BW and daily gain, DG) traits from 6 (weaning) up to 16 (marketing) wk of age, as well as the estimation of the non-genetic factors affecting these traits. Tests of significance revealed that month of birth and litter size at birth succeeded to prove significance for all growth traits, besides feed type for DG at all age stages studied. Significance also was detected for the effect Mating Group on BW and DG traits except at later age stages 14 & 16 for BW and 14-16 for DG. Parity also affected significantly growth traits, except BW at 8, 14 &16 and DG at 12-14 wk. of age. Sex affected BW and DG not significantly at all age stages except that at 16 wk of age for BW and 14-16 wk. of age in case of DG. BG*Sex interaction failed to prove any significance on any of the traits investigated at any of the age spans considered.

INTRODUCTION

The main purposes of crossing is to produce superior crosses (i.e. make use of hybrid vigor), to improve fitness and fertility traits and to combine different characteristics in which the crossed breeds were premium. Therefore, this study was conducted to evaluate genetically body weight, BW and daily gain, DG traits from weaning (at 6 wk.) up to marketing (at 16 wk.) age, using diallel crossing scheme, involving Baladi Black, BB (as a local breeds) with New-Zealand White, NZW (as an exotic one); to estimate the importance of some genetic (Mating Group, direct additive and maternal additive) and non-genetic factors (feed type, month of birth, sex and litter size at birth) as well as direct heterotic effect on the aforementioned traits. Those, besides the recognition of the optimal Mating Group combination associated with crossbreeding between the two considered breeds.

MATERIALS AND METHODS

This experimental work of this study was accomplished at Kafr-El-Sheikh, Sakha research station, which belongs to Animal Production Research Institute, Ministry of Agriculture, Egypt. Data were obtained from a total of 650 straight-bred (367) and cross-bred (283) weaned rabbits produced from a diallel crossing between two breeds, one acclimatized exotic (i.e. sires and dams of the exotic breed were descendents of the New-Zealand White, NZW rabbits raised under the Egyptian conditions) and the other is a local one (Baladi-Black, BB). The breeding plan permits the simultaneous production of the straight-bred and crossbred rabbits between the two investigated breeds. In the straight-bred groups, bucks were assigned at random to breed the dams, as in case of cross-bred ones, but with a restriction of avoiding half-sib; full-sib and parent-offspring mating.

Body weights, BW were recorded biweekly from 6 (weaning) up to 16 wk. of age (marketing), meanwhile daily gain, DG were computed in intervals of 6-8, 8-10, 10-12, 12-14 and 14-16 wk. of age. All Mating Groups were divided randomly into two groups each was fed on one of two types of a commercial crumpled (harshly regrinded after pelleting) or a pelleted diet, each containing approximately 16.1% crude protein, 2.39% crude fat and 12.8% crude fiber. Feed and water were provided *ad libitum.* Mixed model Least Squares and Maximum Likelihood Computer Program PC version 2 (Harvey, 1990) was used for analyzing the data. The linear fixed model adopted for the analysis comprised the effects of Mating Group, BG (4 classes); Sex (males and females); Feed Type (pelleted with 1 cm. Long and 4 mm. diameter or crumpled); Month of Birth, MOB (from November till May); Parity (from the 1st till the 3rd) and litter size at birth; as well as the interactions between BG*Sex and BG*Feed Type. Crossbreeding effects (Additive maternal G^m; direct additive G^i; direct heterotic H^i effects) on BW or DG traits were derived applying a selected set of linear contrasts on Mating Groups' least squares means (Dickerson, 1992).

RESULTS AND DISCUSSION

Means and coefficients of variation of uncorrected records: Simple statistics for all straight-bred and cross-bred Mating Groups peculiar to individual BW or DG traits (from 6, weaning till 16 wk. of age, marketing) are given in table 1. Coefficient of variability (CV%) of BW or DG traits ranged between 19.8 – 33.6 and 27.6 – 46.6, res. in case of pure rabbits, meanwhile it extended from 13.6 – 36.5 and 23.6 – 49.7, res. with impures. Estimates of CV% given in Table 1 showed a general trend indicating that BW or DG traits phenotypic variations decreased with advance of rabbits' age.

Table 1: Actual means (grams) and standard deviation (SD) for body weight and daily gain traits of various mating group (BG) from 6 (weaning) up to 16 wk. age (marketing).

Mating group		Body Weight (Age, wk.)											
Straight -bred		**6**		**8**		**10**		**12**		**14**		**16**	
NZW	X:SD	544	171	743	206	938	226	1143	277	1265	266	1342	265
BB	X:SD	504	169	743	219	917	292	1118	332	1268	265	1338	278
Cross-bred													
NZW*BB	X:SD	503	175	705	205	862	247	1054	289	1246	215	1345	183
BB*NZW	X:SD	505	185	755	217	942	230	1153	267	1341	253	1453	253

		Daily Gain (Period, wk)									
		6-8		**8-10**		**10-12**		**12-14**		**14-16**	
Straight-bred											
NZW	X:SD	13.2	6.1	13.4	4.6	13.8	4.5	13.3	4.2	12.3	4.0
BB	X:SD	15.8	7.4	13.7	6.3	14.0	5.1	13.5	3.7	12.0	3.5
Cross-bred											
NZW*BB	X:SD	13	6.6	12	5.6	13	4.8	14	3.7	12	2.9
BB*NZW	X:SD	16.3	6.6	14.8	4.6	14.8	4.2	15.2	4.1	14.5	4.0
+ Crosses)	X:SD	**14.3**	**6.7**	**13.4**	**5.2**	**13.8**	**4.7**	**13.8**	**4.0**	**12.7**	**3.8**

Month of birth effect was found to be highly significant on BW or DG at different age stages, table 2. Variations due to Month-of-birth effects could be attributed to differences in the prevailing ambient temperature from one month to another and/or the monstrous monthly environmental variations on weaning weight through the amount of milk secreted by the nursing does, on the quality and quantity of the ingested feeds, on the appetite of the growing rabbits as well as on feed utilization capability of these youngs. Least squares means (LSM) listed in Table 3 show that there was a general trend denoting that rabbits born during November and December attained frequently the highest figures concerning traits investigated, meanwhile those born during April and May generally attained the lowest.

Parity was detected to exert a significant source of variation on BW or DG of rabbits at most studied age stages except those at 8; 14 and 16 wk. of age in case of BW and 12-14 wk. of age for DG (Table 2a & b). LSM, table 3 shows a consistent trend for the effect of parity on BW or DG indicating that the 1st parity in general attained the superlative DG traits, while the 3rd one was generally the heaviest considering BW. Afifi and Emara, 1984 suggested that parity effect might be due to changes in the attitude of physiological efficacy of the rabbit dam, which remodel from parity to another.

Table (2a): Least squares means (gm) of factors affecting body weight from 6 (weaning) up to 16 wk. of age (marketing).

	Age in weeks					
	6	**8**	**10**	**12**	**14**	**16**
Breed group	****	*	**	**	ns	ns
NZW	604±14.6	810±21.7	1009±26.8	1248±33.4	1385±45.2	1462±57.5
BB	518±17.3	757±24.8	930±30.7	1149±38.6	1331±49.5	1447±68.0
NZW × BB	580±17.6	771±24.4	948±29.8	1140±37.0	1298±69.8	1437±78.8
BB × NZW	532±15.4	793±22.0	1006±27.6	1221±35.2	1437±46.7	1540±49.5
Feed	****	***	ns	Ns	ns	ns
Pelleted	503±13.9	755±20.5	959±25.4	1190±32.4	1368±37.4	1503±46.4
Crumpled	613±13.2	811±19.9	988±24.2	1190±30.2	1359±53.1	1440±62.7
Parity	**	ns	*	***	ns	ns
1st	521±15.1	783±22.2	976±27.5	1206±35.0	1371±43.3	1537±52.2
2nd	543±13.6	765±20.7	930±25.4	1107±31.7	1336±42.1	1454±45.9
3rd	612±23.3	799±32.0	1014±39.3	1256±48.7	1382±75.7	1423±113.
Sex	ns	ns	ns	ns	ns	**
Males	557±13.5	778±19.9	962±24.3	1181±30.7	1353±44.0	1423±50.8
Females	559±13.0	787±19.8	985±24.4	1198±30.6	1373±41.7	1520±53.7
Month of birth	****	****	****	****	****	****
November	549±24.0	774±31.2	1009±38.3	1244±47.4	1532±62.3	1787±87.8
December	638±20.7	850±27.2	1076±33.5	1280±41.3	1452±55.5	1503±63.5
January	632±17.9	820±23.5	1021±28.8	1232±35.6	1288±49.9	1334±61.9
February	622±18.9	858±25.2	1050±31.3	1319±39.2	1327±61.1	1397±77.4
March	636±16.2	873±21.8	1031±26.6	1270±32.8	1464±58.1	1495±77.8
April	517±21.9	701±30.8	821±37.5	1054±46.6	1115±80.3	1313±88.3
May	315±46.4	602±74.2	806±95.6	929±128.1		

* = Significant at (P ≤0.05); ** = significant at (P ≤0.01); *** = significant at (P ≤0.001); **** = significant at (P ≤0.0001). ns=not significant.
Sire- breed is proceeding dam breed.
NZW = New Zealand White; BB = Baldi Black.

Sex differences in BW or DG of rabbits at all post-weaning studied age spans, table 2 didn't prove any significance (except on BW at 16 wk and DG at 14-16 wk. of age). Likewise, Hanna, 1992; Youssef, 1992 and Abdel-Raouf, 1993; El-Raffa, 1994; Ahmed, 1997 and Ali, 1998 and Abdel-Azez, 1998 showed no significant sex effect on BW and/or DG of rabbits during most age intervals. LSM of DG (Table 3) show that females transcend, in general males at most ages with a relatively small difference between them.

Feed type: No detectable differences for effect of feed type on BW at most ages studied excluding the early age spans after weaning (i.e. at 6 and 8 wk. of age). However, differences between the effects of crumpled and pelleted (Table 2) feed types on post-weaning DG of rabbits was significant at most age stages except that at 12-14 wk. of age, in favor of pelleted feeds. However, judging from DG, these results may affirm that re-grinding of pelleted feeds for weaned and growing rabbits was not advantageous meanwhile, results of BW claim that harsh grinding is expedient at primordial age intervals until the chewing and digestive apparatus being well developed.

Table (2b): Least squares means (gm) of factors affecting body weight gain from 6 (weaning) up to 16 wk. of age (marketing).

	Daily gain (periods in weeks)				
	6-8	8-10	10-12	12-14	14-16
Mating groups:	****	****	***	*	NS
NZW	12.36±0.78	13.25±0.63	14.44±0.59	13.41±0.71	13.19±0.81
Baldi Black (BB)	14.77±0.89	13.41±0.72	14.13±0.69	13.19±0.78	13.57±0.96
NZW × BB	11.39±0.87	11.69±0.70	12.35±0.66	10.70±1.10	12.08±1.12
BB × NZW	16.58±0.79	15.69±0.64	15.42±0.63	14.70±0.73	14.75±0.70
Feed:	****	****	****	NS	***
Pelleted	15.51±0.73	14.74±0.60	15.24±0.58	14.57±0.59	14.65±0.66
Crumpled	12.04±0.71	12.28±0.57	12.93±0.54	11.57±0.83	12.14±0.89
Parity	***	***	****	NS	***
1st	16.03±0.80	15.06±0.65	15.43±0.62	13.99±0.68	15.20±0.74
2nd	14.14±0.74	12.72±0.59	12.65±0.56	12.81±0.66	12.84±0.65
3rd	11.16±1.14	12.77±0.92	14.18±0.87	12.41±1.19	12.16±1.60
Sex:	NS	NS	NS	NS	**
Males	13.55±0.71	13.14±0.57	13.87±0.55	12.92±0.69	12.70±0.72
Females	14.01±0.70	13.89±0.57	14.30±0.54	13.22±0.66	14.10±0.76
Month of birth:	****	****	****	****	****
November	15.20±1.12	15.57±0.90	16.18±0.84	17.71±0.98	17.78±1.24
December	13.93±0.98	14.70±0.79	14.72±0.74	13.58±087	12.57±0.90
January	12.70±0.84	13.05±0.67	13.70±0.63	11.43±0.78	11.35±0.88
February	15.10±0.90	14.23±0.73	15.75±0.70	11.71±0.96	11.71±1.10
March	15.32±0.78	13.15±0.62	14.42±0.58	13.59±0.91	13.59±1.10
April	9.63±1.10	9.19±0.88	11.83±0.83	10.39±1.26	13.38±1.25
May	14.54±2.66	14.68±2.24	11.98±2.28		

* = Significant at (P ≤0.05); ** = significant at (P ≤0.01); *** = significant at (P ≤0.001); **** = significant at (P ≤0.0001). ns=not significant.
Sire- breed is proceeding dam breed.
NZW = New Zealand White; BB = Baldi Black.

Mating Group differences were generally significant for weaning and post–weaning BW or DG traits at various age stages (Table 2) except at 14 and 16 wk. of age for BW and 14-16 wk. of age for DG. LSM presented in table 3, revealed that values of the cross that sired by BB bucks (i.e.BB*NZW), at almost all age stages and for considered traits, excelled its reciprocal cross which genitored by NZW males.

Straight-bred differences Results given in Table 3 revealed that there wasn't a general trend of superiority ranking could be detected. However, though NZW rabbits surpassed (significantly at most ages) BB ones for BW at all ages considered, BB gained the superiority concerning DG at all ages except at 10-12 and 12-14 wk. However, the later differences were not significant except at 6-8 wk. of age.

Table (3): Linear function (±Standard error, SE) of straight-bred differences and crossbreeding effects pertaining body weight and daily gain traits from 6 (weaning) up to 16 wk. Of age (marketing).

	Trait		Age in weeks					
			6 *	8	10	12	14	16
				6- 8	8-10	10-12	12-14	14-16
Straight-bred difference:								
NZW vs. Baldi black	BW		85.9± 15.9***	53.1± 20.5*	78.5± 25.7**	99.2± 32.0**	54.5±39.1	15.5±57.5
	DG		----------	-2.4± 0.7***	-0.2±0.6	0.3±0.6	0.2±0.6	-0.4±0.8
Direct heterosis:								
	BW	Units	-5.0±12.8	-1.1±16.8	7.5±21.1	-18.0±26.2	10.4±40.5	33.6±48.2
NZW × Baldi black		%	-9.77	-6.84	-6.89	-7.80	-4.68	-3.57
	DG	Units	-------------	0.4±0.6	0.4±0.5	-0.4±0.5	-0.5±0.6	0.04±0.7
		%	-------------	8.13	1.03	-3.79	8.67	0.29
Direct additive:	BW		67.4± 12.6***	15.2± 16.2	10.2± 20.2	9.2±25.3	-43.1±40.5	-43.9±48.0
	DG		------------	-3.8± 0.6***	-2.1± 0.5***	-1.4±0.4**	-1.8±0.6**	-1.5±0.7*
Maternal additive:	BW		-48.9± 19.1*	22.7± 24.7	58.0± 30.8	80.9±38.6*	140.6± 71.7	103.3± 77.8
	DG		-------------	5.2± 0.9***	4.0± 0.7***	3.1±0.7***	3.7±1.1**	2.7±1.1*

* For body weight traits.

Heterotic effect estimates (H^i) calculated in units (g.) and as percentage (%) for post weaning BW and DG traits, (Table 3) were generally equivocal. Fortunately, these negative direct heterosis estimates were not significant at all age stages for any of the traits considered. These findings may convince us to conclude that crossbreeding exploiting Baldi-Black rabbits and NZW ones was of trivial consequence for promoting BW and DG traits during the age periods under consideration (from weaning up to 16 wk. of age). Howbeit, negative direct heterosis, if any, might be attributable to directional dominance of genes affecting these traits. However, separate-cross heterotic effect (which can be deduced easily from the value of the maternal additive), revealed some positive estimates which concentrates in the verge of the cross (BB*NZW). Fortunately again, these positive heterosis estimates were found to be significant in most age stages for DG traits except at 14-16 wk. of age. This may notify us to focus on using BB as the terminal sire breed with NZW does to secure appreciable heterotic effect. These data also might lead us to conclude that at least a considerable part of genes affecting these traits lies on the sex chromosomes. In this respect, Falconer, 1989 showed that a cross between two base populations would show heterosis if they differ in the frequency of genes affecting a given trait. The same author also added that the negative sign of heterosis could be attributed in some cases to the nature of the measurement (e.g. if the trait is expressed in another way such as the reciprocal of the present, the heterosis would be positive in sign).

Direct additive effect on BW and DG traits was significantly in favor of BB bucks except body weight at 6 wk of age. Afifi et al, 1994 with NZW and BR, retrieved that direct additive effect was not significant on BW at 5, 6 & 8 and DG during the intervals of 5-6 & 10-12 wk. of age, while the same effect exhibited significance on BW at 10 & 12 wk. of age and on DG during the periods of 6-8 and 8-10 wk. of age. The present results indicate that paternity of

BB rabbits is better compared with NZW ones. These results confirming the use of BB as terminal sire-breed for the engendering of broiler rabbits.

Maternal additive effect: Results in table 4 proved that maternal additive effect on BW and DG was positive and significant in preference of NZW at all considered age periods. Linear contrasts show that NZW-dammed crosses excelled those mothered by Baladi rabbits for the previously mentioned traits, though significance was lacking for BW except at 6 wk of age favoring BB. These results lead to state that does of NZW rabbits is better concerning their mothering ability on post weaning growth traits considered especially DG. Therefore, it may be recommended to use NZW does as a terminal dam-breed in crossing programs that comprise these two breeds. In this respect, Ali, 1998 using Cal and Al-Gabali rabbits, proved that maternal additive effect on BW at 4, 8, 12 and 16 as well as DG during 4-8, 8-12 and 4-16 wk. of age of Egyptian Al-Gabali rabbits, was negative and significant ($P \leq 0.01$ or $P \leq 0.001$). However, Abdel-Aziz, 1998 with NZW and Al-Gabali rabbits declared that maternal additive effect on BW was positive and significant ($P \leq 0.05$ or $P \leq 0.01$) in favor of Al-Gabali meanwhile it wasn't significant in light of DG

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