# Crossbreeding Effects of Weaning and Post-Weaning Body Measurements of Bauscat and Baladi Red Rabbits

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***Received: 13/6/2007***

**Abstract:** Data on 2305 rabbits which consists of 1211 straight-bred and 1094 cross-bred individuals, produced from crossing of an exotic (Bauscat, B) and a native (Baladi Red, BR) rabbit breed. The Experimental work was done at the Rabbit Farm, Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Nasr City Cairo, Egypt, for three consecutive years of production starting from September 1998. In this study direct heterosis as well as maternal and direct additive effects for some body measurements traits (*i.e.* Body length, BL; Loin length, LL; Chest circumference, CC; Chest width, CW and Loin width, LW) from weaning (4 weeks) up to marketing (14 weeks) were estimated. Effects of mating groups and straight-bred differences on measurements traits (BL, LL, CC, CW and LW) were found to be significant ($P \leq 0.05$, $P \leq 0.01$ or $P \leq 0.001$) at most ages studied. Contrasts between Bauscat and Baladi Red rabbits for body measurements indicated the superiority of Bauscat rabbits over Baladi Red ones in measurements traits at all studied weeks. These differences were mostly significant ($P \leq 0.05$, $P \leq 0.01$or $P \leq 0.001$) at all weeks studied except at 4 wks for BL, at 8 wks for LL, at 4 and 8 wks for CC and CW at 4 wks for LW during which they lack significance. Estimates of direct heterosis was positive and significant ($P \leq 0.05$, $P \leq 0.01$ or $P \leq 0.001$) for most body measurements at 4, 8, 12, and 14 wks of ages. Crossing between B and BR rabbits was generally in favor of Bauscat sired rabbits for most body measurements traits except for BL at 8, LL at 4, 12 and 14 weeks, CC at 8 and 14 and CW at 4 wks of age all through the superiority were in favor of Baladi Red sired progeny. Contrast of maternal additive effect on body measurements were positive and significant ($P \leq 0.01$ or $P \leq 0.001$) on most body measurements except at 4 weeks for BL and LL, at 4 and 14 weeks for CC while at 4, 8 and 14 weeks for CW whilst the differences were non-significant. Results indicated that B as a dam breed are by some means better than BR for body measurements in simple crossbreeding programs including these two rabbit breeds. However, reciprocal recurrent selection would improve the nicking ability of those breeds to be used as precursors of broiler rabbits.

**Keywords**: Rabbits crossing, body length, chest circumference, Heterotic effect, maternal additive, direct additive.

## INTRODUCTION

Several Egyptian studies (e.g. Afifi, 1971; Afifi and Khalil, 1989; Oudha, 1990; El-Dessoki, 1991; Afifi *et al.*, 1994; Khalil *et al.*, 1995 and Abdel-Aziz, 1998, Gharib, 2004; Attalah, 2005) evidenced, in general, that crossing local breeds of rabbits (e.g. Baladi, Baladi Red, Baladi Black, Giza White, ..etc.), with exotic breeds (e.g. Bauscat, Californian, New Zealand White ... etc.) was associated with improvement in progeny growth traits. Promptly few studies were carried out to evaluate body measurements of native and exotic breeds of rabbits under the Egyptian conditions (Hassan, 1988; El-Mahdy, 1998; Abdel-Ghany *et al.*, 2001 and Hassan *et al.*, 2001). Live animals body length (from the atlas vertebra to the 7$^{th}$ lumber vertebra, i.e. dorsal length as cited by Ouhayon and Blasco *et al.* (1992) and Paci *et al.* (1997) which was to some extent compatible to carcass trunk length LI as cited by Blasco *et al.* (1992) constitutes the frame upon which meat would be deposited. Chest circumference measures could play a role in the rabbit overall tidal air during breathing which in turn affect its healthiness; fitness; vigor and strength. Though of relatively slight attention, these type traits may explain a relatively undersized, but potentially important amount of variability in growth measures of rabbits. The importance of these traits is easily recognized but it is not well documented in scientific literature. Therefore, these secondary traits may have a role in classic breeding programs (Abdel-Ghany *et al.*, 2001 and Hassan *et al.*, 2001). However, no noteworthy data were available in the literature on development of body measurements in rabbits (Bersenyi *et al.*, 1998). The objective of the present study was to investigate some crossbreeding effects (breeding group, direct heterosis ($H^I$), direct ($G^I$) and maternal ($M^I$) additive effects on body measurements in a crossbreeding experiment involving an exotic Bauscat (B) and a native Egyptian Baladi Red (BR) rabbits.

## MATERIALS AND METHODS

The experimental work was carried out during three consecutive years of production starting in September 1998 till October 2001, on the Experimental Rabbit flock maintained by the Department of Animal Production, Faculty of Agriculture, Al-Azhar University; Nasr City; Cairo; Egypt. Animals used in this study included one local Egyptian rabbit breed (*i.e.* Baladi Red, BR) and one exotic (*i.e.* Bauscat, B). The managerial processing, housing system and ration feeding were described by (Farid *et al.*, 2006).

Maxed Model Least Squares and Maximum Likelihood Computer Program PC version 2 (Harvey, 1990) was used for analyzing the data. Effects of breed group; direct heterosis, maternal additive and direct additive effects on some body measurements (Body length, BL; Loin length, LL; Chest circumference, CC;

chest width, CW and loin width, LW) from weaning age (4 wks) up to marketing (14 wks) were evaluated. Data were analyzed applying the following mixed mathematical model:

$$Y_{ijklmn} = \mu + M_i + Y_j + Se_k + P_l + Sx_m + e_{ijklmn}$$

Where:

$Y_{ijklmn}$= The observation on the ijklmn$^{th}$ individual as regard to studied growth traits;

$\mu$ = Overall mean, common element to all observations;

$M_i$ = fixed effect of the i$^{th}$ breed group;

$Y_j$ = fixed effect of the j$^{th}$ year of kindling

$Se_k$ = fixed effect of the k$^{th}$ season of kindling;

$P_l$ = fixed effect of the l$^{th}$ parity;

$Sx_m$ = fixed effect of the m$^{th}$ sex and

$e_{ijklmn}$ = random deviation of the n$^{th}$ individual of the i$^{th}$ breed group assumed to be independently randomly distributed, i.e. N.D (0, $\sigma^2$e).

**Genetic model and estimation of crossbreeding effects:**

Crossbreeding effects (maternal additive, direct additive and direct heterosis) on different traits were estimated according to Dickerson 1992. The genetic model permitted deriving the crossbreeding effects using a selected set of linear contrasts. These linear contrasts on mating group least-squares means were computed to quantify differences attributable to direct additive (sire breed), maternal additive (reciprocal crosses difference) and direct heterotic effect as follows:

**Purebred differences:**

$\{(G^i{}_B + G^m{}_B) - (G^i{}_{BR} + G^m{}_{BR})\} = (B \times B) - (BR \times BR)$.

**Direct heterosis effect:**

$H^i{}_{B \times BR} = \{(B \times BR)+(BR \times B)\} - \{(B \times B + BR \times BR)\}$.

**Direct additive effect (Sire Breed):**

$(GiB-GiBR) = \{[(B \times B)+(B \times BR)]-[(BR \times BR)+(BR \times B)]\}$.

**Maternal additive effect:**

$(G^m{}_B - G^m{}_{BR}) = [(BR \times B) - (B \times BR)]$.

Where:-

$G^i$ and $G^m$ represent direct additive and maternal additive effects, respectively, of the subscripted breed (genetic) group. Each single degree of freedom contrast was tested for significance with the Student's t-test.

## RESULTS AND DISCUSSION

**Mating groups (MG):**

Breed group effect on body measurements traits are presented in tables (1 through 5). Breed group effect on body length was found to be significant (P≤ 0.001) at 12 and 14 weeks, in this regard, (Abdel-Ghany *et al.*, 2001), noticed that mating group effect was non-significant at 4 and 8 wks of age, meanwhile Oetting *et al.* (1991) reported the same trend on body measurements with different rabbit breed groups and their crosses but breed group effect on body length recorded at different ages was non-significant. MG effect on Loin length was found to be significant (P≤ 0.05, P≤ 0.01 or P≤ 0.001) at 4, 12 and 14 weeks. In this regard, El-Mahdy, 1998, reported non-significant MG effect on Loin length at 8 wks of age. Effect of MG on chest circumference was found to be significant (P≤ 0.01 or P≤ 0.001) at 8, 12 and 14 wks. However, Hassan *et al.*, 2001, concluded non-significant of MG on chest circumference at 4 and 8 weeks. The same trend was also observed by Oetting *et al.*, 1991 with diverse miscellaneous rabbits' breed groups. MG effect on chest width and loin width was found to be significant (P≤ 0.05, P≤ 0.01 or P≤ 0.001) at all ages studied.

Data revealed that Bauscat breed group recorded the highest measurement traits performance at most ages studied.

**Straight-bred differences:**

Linear contrasts between Bauscat and Baladi Red rabbits for body measurements traits are given in tables (1 through 5). These contrasts declared a general superiority of Bauscat rabbits over Baladi Red ones in body measurements at most ages studied. The differences were mostly significant (P≤ 0.05, P≤ 0.01or P≤ 0.001) for body measurements at all ages studied except at 4 wks for body length, at 8 wks for loin length, at 4 and 8 wks for chest circumference and chest width, at 4 wks for loin width. In this respect, Hassan *et al.*, 2001 on Chest circumference and Abdel-Ghany *et al.*, 2001 on body length, indicated a general superiority of the exotic rabbit breeds against local ones.

**Direct Heterotic effect ($H^i$):**

Estimates of direct heterosis ($H^i$) calculated in actual units (cm.) for body measurements are given in tables (1 through 5). These estimates show that direct heterosis was positive and significant (P≤ 0.05, P≤ 0.01 or P≤ 0.001) for most body measurements at 4, 8, 12, and 14 wks of ages. These results indicate that crossing between B and BR rabbits was generally associated with improvement in all body measurements at most ages evaluated. These findings were in agreement with those reported by (Hassan *et al.*, 2001) on Chest circumference and (Abdel-Ghany *et al.*, 2001) on body length, using Baladi Red rabbits as a sire breed in crossbreeding programs of rabbits would be indisputably and definitely advantageous to improve Chest circumference and body length, specially at the age periods considered by them which were comparable to those reported herein. Oetting *et al.* (1991) reported that the largest significant difference could be seen in increased body length and Chest circumference by $F_1$ (in kits from crossing Japanese and New Zealand) individuals.

Heterosis or hybrid vigor for a certain character is existing when the average performance of crossbred progeny is superior to the average performance of the two parents. The amount of heterosis can vary practically, depending on the environment and on the populations being crossed. Theoretically, the magnitude of heterosis is inversely related to the degree of genetic resemblance between parental populations (Willham and Pollak, 1985) and it is expected to be proportional to the degree of heterozygosity of the crosses (Sheridan, 1981 and Hill, 1982). This is of major genetic importance for any long-term breeding program that is undertaken to design a production strategy involving complex multibreed individuals.

Howbeit, negative direct heterosis, if any, might be attributable to directional dominance of genes affecting these traits. Differences in the direction and magnitude of specific cross heterotic effects might lead us to assume 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 (i. e. if the trait is expressed in another way such as the reciprocal of the present the heterosis would be positive in sign).

However, reciprocal recurrent selection could possibly magnify the utilization of non-additive genetic effects for the studied measures. It is worthwhile to reveal that $H^i$% of conformation measures studied tends to increase rather linearly or curve-linearly with age which may indicate that $H^i$ in these age spans is age dependent.

**Direct additive effect ($G^i$):**

Linear contrasts of direct additive (sire breed) on body measurements at 4, 8, 12 and 14 weeks of ages are given in tables (1 through 5). These estimates show that direct additive was positive and significant ($P\leq 0.05$, $P\leq 0.01$ or $P\leq 0.001$) for most body measurements at 4, 8, 12, and 14 wks of age. These results indicated that crossing between B and BR rabbits was generally in favor of Bauscat sired rabbits for most body measurements traits except body length at 8 wks, for loin length at 4, 12 and 14 wks, for Chest circumference at 8 and 14 wks and for chest width at 4 wks was in favor of Baladi Red sired rabbits. In this respect Hassan *et al.*, 2001 on chest circumference and Abdel-Ghany *et al.*, 2001 on body length, observed the superiority of Baladi breeds regarding direct additive effects which in turn suggests that the use of these as a sire breed in crossbreeding programs would be beneficial in improving body growth traits for the production of Broiler rabbits judging from conformational measures.

Crossing not only takes advantage of characters with considerable non-additive genetic variations (i.e. dominance and epistasis), but also exploits differences in additive effects (i.e. differences in average performance between populations as a deviation from the overall mean) between populations (Ahmed, 2003). On the level of loci responsible for a given trait, complemntarity between additive effects of genes occupying these loci play an important role in the manifestation of $G^i$. Furthermore, Lewczuk *et al.* (1996) investigated the effect of terminal sires of Danish White rabbits on body measurements (i.e. body length; thigh length; chest circumference and loin width) and revealed that most of these measurements, disregarding loins width, were to great extent similar at the sire groups.

**Maternal additive effect ($M^i$):**

Linear contrasts of maternal additive (sire breed) on body measurements at 4, 8, 12 and 14 weeks of ages are given in tables (1 through 5). Contrast of $M^i$ effect on body measurements were positive and significant ($P\leq 0.01$ or $P\leq 0.001$) on most body measurements except at 4 wks for body length and loin length, at 4 and 14 wks for chest circumference and 4, 8 and 14 wks for chest width where they were non-significant

Contrast, showed that differences were in esteem and reverence of Bauscat rabbits at 8 and 12 wks of age for body length, at 4, 12 and 14 wks for loin length, at 8 and 14 wks for chest circumference and loin width and at 4 wks for chest width.

These results lead to assert and affirm that B rabbits are better mothers for body measurements than BR rabbits in simple crossbreeding programs including these two breeds. However, Abdel-Ghany *et al.*, 2001 and Hassan *et al.*, 2001 showed that the exotic breed (*i.e.* New Zealand White rabbits) has better mothering capacity for post weaning body length and chest circumference than either of Baladi Red and Black breeds respectively in plain broiler rabbit-crossing programs.

Maternal effect consists mainly from additive maternal and cytoplasmic-inheritance. However, the maternal effect herein could be confounded with the reciprocal effect (i. e. sex linkage). The latter effect is due to additive consequences of the genes concerned and carried on the sex chromosomes. In this respect, certain crosses show much more maternal complementarities than others depending on the extent to which the crossed populations differ in reproductive performance and in production characters, and also on the direction of the cross. It is clearly obvious that there would be far greater complementarity when the most prolific population is used as a source of dams rather than of sires. Therefore, this type of effect is dependent on the direction of the crossing (Ahmed, 2003).

**Table (1):** Least squares mean estimates of breed group, ± SE, straight-bred difference, direct heterosis ($H^{i}$), maternal additive ($G^{m}$) and direct additive ($G^{i}$) effects on body length recorded at 4, 8, 12 and 14 wks of ages.

| Crossbreeding Effect | Body length at | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 wks | | 8 wks | | 12 wks | | 14 wks | |
| | No. | means ± SE | No. | means ± SE | No. | means ± SE | No. | means ± SE |
| **Breed group means** | | | | | | | | |
| B x B | 726 | 16.8 ± 0.10 | 595 | 23.3 ± 0.12 | 508 | 27.8 ± 0.11 | 506 | 31.4 ± 0.08 |
| BR x BR | 485 | 16.8 ± 0.11 | 400 | 23.1 ± 0.13 | 347 | 27.0 ± 0.12 | 330 | 30.6 ± 0.09 |
| B x BR | 523 | 16.7 ± 0.10 | 472 | 23.1 ± 0.12 | 395 | 26.6 ± 0.11 | 383 | 30.9 ± 0.08 |
| BR x B | 571 | 16.6 ± 0.10 | 466 | 23.4 ± 0.12 | 396 | 26.9 ± 0.11 | 390 | 30.9 ± 0.08 |
| Significance | | ns | | ns | | *** | | *** |
| **Straight-bred differences** | | | | | | | | |
| $\{(G^{i}_{B}+G^{m}_{B})-(G^{i}_{BR}+G^{m}_{BR})\}$ | | 0.011 ± 0.09 | | 0.261 ± 0.11 | | 0.770 ± 0.10 | | 0.795 ± 0.10 |
| Significance | | ns | | * | | *** | | *** |
| **Heterosis ($H^{i}$)** | | | | | | | | |
| $H^{i}_{(B \times BR)}$ | Unit | -0.152 ± 0.07 | | 0.001± 0.08 | | -0.695 ± 0.07 | | -0.092 ± 0.07 |
| Significance | | * | | ns | | *** | | ns |
| | % | 0.090 % | | 0.004 % | | 2.540 % | | 0.300 % |
| **Maternal additive effect** | | | | | | | | |
| $(G^{m}_{B} - G^{m}_{BR})$ | | --0.021 ± 0.10 | | 0.308 ± 0.11 | | 0.281 ± 0.10 | | -0.003 ± 0.10 |
| Significance | | ns | | ** | | ** | | ns |
| **Direct additive effect** | | | | | | | | |
| $(G^{i}_{B} - G^{i}_{BR})$ | | 10.032 ± 0.14 | | -0.047 ± 0.16 | | 0.488 ± 0.14 | | 0.798 ± 0.14 |
| Significance | | ns | | ns | | *** | | *** |

B = Bauscat rabbits, BR = Baladi Red rabbits.
$H^{i}$ % = [$H^{i}$ in unit / (average of B + BR)] x 100.
* = P≤0.05, ** = P≤0.01, *** =P≤0.001, ns = non- significant.

**Table (2):** Least squares mean estimates of breed group, ± SE, straight-bred difference, direct heterosis ($H^{i}$), maternal additive ($G^{m}$) and direct additive ($G^{i}$) effects on loin length recorded at 4, 8, 12 and 14 wks of ages.

| Crossbreeding Effect | Loin length at | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 wks | | 8 wks | | 12 wks | | 14 wks | |
| | No. | means ± SE | No. | means ± SE | No. | means ± SE | No. | means ± SE |
| **Breed group means** | | | | | | | | |
| B x B | 726 | 6.7 ± 0.07 | 595 | 8.3 ± 0.15 | 508 | 9.7 ± 0.14 | 506 | 11.4 ± 0.09 |
| BR x BR | 485 | 5.5 ± 0.07 | 400 | 8.3 ± 0.15 | 347 | 9.5 ± 0.13 | 330 | 11.2 ± 0.09 |
| B x BR | 523 | 5.6± 0.06 | 472 | 8.5 ± 0.14 | 395 | 9.9 ± 0.12 | 383 | 11.5 ± 0.08 |
| BR x B | 571 | 5.8± 0.06 | 466 | 8.1± 0.14 | 396 | 10.9 ± 0.13 | 390 | 11.7 ± 0.09 |
| Significance | | * | | ns | | ** | | *** |
| **Straight-bred differences** | | | | | | | | |
| $\{(G^{i}_{B}+G^{m}_{B})-(G^{i}_{BR}+G^{m}_{BR})\}$ | | 0.142 ± 0.06 | | -0.063 ± 0.14 | | 0.227 ± 0.08 | | 0.146 ± 0.07 |
| Significance | | ** | | ns | | ** | | * |
| **Heterosis ($H^{i}$)** | | | | | | | | |
| $H^{i}_{(B \times BR)}$ | Unit | 0.117 ± 0.04 | | 0.028 ± 0.10 | | 0.339 ± 0.06 | | 0.284 ± 0.05 |
| Significance | | ** | | ns | | *** | | *** |
| | % | 1.91% | | 0.34% | | 3.51% | | 2.51% |
| **Maternal additive effect** | | | | | | | | |
| $(G^{m}_{B} - G^{m}_{BR})$ | | 0.145 ± 0.09 | | -0.368 ± 0.14 | | 0.237 ± 0.08 | | 0.214 ± 0.07 |
| Significance | | ns | | ** | | ** | | *** |
| **Direct additive effect** | | | | | | | | |
| $(G^{i}_{B} - G^{i}_{BR})$ | | -0.003 ± 0.08 | | 0.305 ± 0.19 | | -0.009 ± 0.12 | | -0.068 ± 0.09 |
| Significance | | ns | | ns | | ns | | ns |

B = Bauscat rabbits, BR = Baladi Red rabbits.
$H^{i}$ % = [$H^{i}$ in unit / (average of B + BR)] x 100.
• = P≤0.05, ** = P≤0.01, *** =P≤0.001, ns = non- significant.

**Table (3):** Least squares mean estimates of breed group, ± SE, straight-bred difference, direct heterosis ($H^i$), maternal additive ($G^m$) and direct additive ($G^i$) effects on chest circumference recorded at 4, 8, 12 and 14 wks of ages.

| Crossbreeding Effect | Chest circumference at | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 wks | | 8 wks | | 12 wks | | 14 wks | |
| | No. | means ± SE | No. | means ± SE | No. | means ± SE | No. | means ± SE |
| **Breed group means** | | | | | | | | |
| B x B | 726 | 14.7 ± 0.10 | 595 | 19.3 ± 0.15 | 508 | 22.8 ± 0.12 | 506 | 24.7 ± 0.12 |
| BR x BR | 485 | 14.6 ± 0.10 | 400 | 19.3 ± 0.14 | 347 | 22.5 ± 0.12 | 330 | 24.4 ± 0.12 |
| B x BR | 523 | 14.7± 0.09 | 472 | 19.8 ± 0.13 | 395 | 22.2 ± 0.11 | 383 | 24.4 ± 0.12 |
| BR x B | 571 | 14.6 ± 0.09 | 466 | 19.8± 0.14 | 396 | 22.3± 0.12 | 390 | 24.8 ± 0.12 |
| Significance | | ns | | *** | | *** | | * |
| **Straight-bred differences** | | | | | | | | |
| $\{(G^i_B + G^m_B) - (G^i_{BR} + G^m_{BR})\}$ | | 0.154 ± 0.09 | | -0.054 ± 0.11 | | 0.331 ± 0.10 | | 0.272 ± 0.09 |
| Significance | | ns | | ns | | *** | | ** |
| **Heterosis ($H^i$)** | | | | | | | | |
| $H^i_{(B \times BR)}$ | Unit | -0.022 ± 0.07 | | 0.515± 0.08 | | -0.422 ± 0.07 | | -0.041 ± 0.07 |
| Significance | | ns | | *** | | *** | | ns |
| | % | 0.15% | | 2.67% | | 1.86% | | 0.17% |
| **Maternal additive effect** | | | | | | | | |
| $(G^m_B - G^m_{BR})$ | | -0.100 ± 0.09 | | -0.510 ± 0.11 | | 0.088 ± 0.10 | | 0.322 ± 0.09 |
| Significance | | * | | ns | | ns | | *** |
| **Direct additive effect** | | | | | | | | |
| $(G^i_B - G^i_{BR})$ | | 10.255 ± 0.13 | | -0.003 ± 0.15 | | 0.243 ± 0.14 | | -0.049 ± 0.13 |
| Significance | | * | | ns | | ns | | ns |

B = Bauscat rabbits, BR = Baladi Red rabbits.
$H^i$ % = [$H^i$ in unit / (average of B + BR)] x 100.
* = P≤0.05, ** = P≤0.01, *** =P≤0.001, ns = non- significant.

**Table (4):** Least squares mean estimates of breed group, ± SE, straight-bred difference, direct heterosis ($H^i$), maternal additive ($G^m$) and direct additive ($G^i$) effects on chest width recorded at 4, 8, 12 and 14 wks of ages.

| Crossbreeding Effect | Chest width at | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 wks | | 8 wks | | 12 wks | | 14 wks | |
| | No. | means ± SE | No. | means ± SE | No. | means ± SE | No. | means ± SE |
| **Breed group means** | | | | | | | | |
| B x B | 726 | 5.0± 0.12 | 595 | 9.1 ± 0.14 | 508 | 12.0 ± 0.13 | 506 | 13.3 ± 0.11 |
| BR x BR | 485 | 4.9 ± 0.11 | 400 | 9.3 ± 0.14 | 347 | 11.0 ± 0.13 | 330 | 12.7 ± 0.11 |
| B x BR | 523 | 4.4 ± 0.11 | 472 | 9.5 ± 0.13 | 395 | 11.3 ± 0.11 | 383 | 12.9 ± 0.11 |
| BR x B | 571 | 4.7 ± 0.11 | 466 | 9.0± 0.14 | 396 | 10.6 ± 0.12 | 390 | 12.6 ± 0.11 |
| Significance | | *** | | ** | | *** | | *** |
| **Straight-bred differences** | | | | | | | | |
| $\{(G^i_B + G^m_B) - (G^i_{BR} + G^m_{BR})\}$ | | 0.098 ± 0.06 | | -0.167 ± 0.10 | | 0.959 ± 0.09 | | 0.579 ± 0.09 |
| Significance | | ns | | ns | | *** | | *** |
| **Heterosis ($H^i$)** | | | | | | | | |
| $H^i_{(B \times BR)}$ | Unit | -0.420 ± 0.04 | | 0.055± 0.07 | | -0.431 ± 0.06 | | -0.260 ± 0.06 |
| Significance | | *** | | ns | | *** | | *** |
| | % | 8.48% | | 0.60% | | 0.37% | | 2.08% |
| **Maternal additive effect** | | | | | | | | |
| $(G^m_B - G^m_{BR})$ | | 0.222 ± 0.06 | | -0.521±0.10 | | -0.437 ± 0.09 | | -0.353 ± 0.09 |
| Significance | | *** | | *** | | *** | | *** |
| **Direct additive effect** | | | | | | | | |
| $(G^i_B - G^i_{BR})$ | | -0.124 ± 0.08 | | 0.355 ± 0.14 | | 1.395 ± 0.13 | | 0.933 ± 0.12 |
| Significance | | ns | | ** | | *** | | *** |

B = Bauscat rabbits, BR = Baladi Red rabbits.
$H^i$ % = [$H^i$ in unit / (average of B + BR)] x 100.
* = P≤0.05, ** = P≤0.01, *** =P≤0.001, ns = non- significant.

**Table (5):** Least squares mean estimates of breed group, ± SE, straight-bred difference, direct heterosis ($H^i$), maternal additive ($G^m$) and direct additive ($G^i$) effects on loin width recorded at 4, 8, 12 and 14 wks of ages.

| Crossbreeding Effect | | Loin width at | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 wks | | 8 wks | | 12 wks | | 14 wks | |
| | No. | means ± SE | No. | means ± SE | No. | means ± SE | No. | means ± SE |
| **Breed group means** | | | | | | | | |
| B x B | 726 | 3.7 ± 0.05 | 595 | 5.2 ± 0.07 | 508 | 6.2 ± 0.05 | 506 | 7.1 ± 0.05 |
| BR x BR | 485 | 3.7 ± 0.05 | 400 | 5.0 ± 0.07 | 347 | 6.0 ± 0.05 | 330 | 6.8 ± 0.05 |
| B x BR | 523 | 3.8 ± 0.05 | 472 | 5.3 ± 0.07 | 395 | 7.0 ± 0.05 | 383 | 7.2 ± 0.05 |
| BR x B | 571 | 3.8 ± 0.05 | 466 | 5.2 ± 0.07 | 396 | 6.1± 0.05 | 390 | 7.2 ± 0.05 |
| Significance | | * | | *** | | *** | | *** |
| **Straight-bred differences** | | | | | | | | |
| $\{(G^i_B + G^m_B) - (G^i_{BR} + G^m_{BR})\}$ | | 0.023 ± 0.03 | | 0.342 ± 0.05 | | 0.219 ± 0.04 | | 0.345 ± 0.04 |
| Significance | | ns | | * | | *** | | *** |
| **Heterosis ($H^i$)** | | | | | | | | |
| $H^i_{(B\times BR)}$ | Unit | 0.121 ± 0.02 | | 0.046 ± 0.03 | | -0.044 ± 0.03 | | 0.185 ± 0.03 |
| Significance | | *** | | ns | | ns | | *** |
| | % | 3.27% | | 0.46% | | 0.36% | | 2.66% |
| **Maternal additive effect** | | | | | | | | |
| $(G^m_B - G^m_{BR})$ | | -0.053 ± 0.03 | | -0.083 ± 0.05 | | 0.137 ± 0.04 | | 0.007 ± 0.04 |
| Significance | | ns | | ns | | *** | | ns |
| **Direct additive effect** | | | | | | | | |
| $(G^i_B - G^i_{BR})$ | | 0.076 ± 0.05 | | 0.425 ± 0.06 | | 0.083 ± 0.05 | | 0.339 ± 0.06 |
| Significance | | ns | | *** | | ns | | *** |

B = Bauscat rabbits, BR = Baladi Red rabbits.
$H^i$ % = [$H^i$ in unit / (average of B + BR)] x 100.
$^*$ = P≤0.05, $^{**}$ = P≤0.01, $^{***}$ =P≤0.001, $^{ns}$ = non- significant.

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# التأثيرات الوراثية لبعض مقاييس الجسم عند الفطام و بعد الفطام الناتجة من خلط سلالة الأرانب البوسكات مع البلدي الأحمر

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استخدم فى هذه الدراسة عدد ٢٣٠٥ من الأرانب المفطومة من الجيل الأول منها ١٢١١ أفراد نقية و ١٠٩٤ أفراد خليطة ناتجة من تجربة خلط استخدم فيها سلالتان إحداها أجنبية وهى البوسكات والأخرى محلية وهى البلدي الأحمر. أجريت هذه الدراسة في مزرعة الأرانب البحثية بكلية الزراعة- جامعة الأزهر بمدينة نصر- مصر خلال ثلاثة سنوات إنتاجية متتالية بدأت في سبتمبر ١٩٩٨م حتى أكتوبر ٢٠٠١م وذلك لدراسة بعض التأثيرات الوراثية لصفات مقاييس الجسم (طول الجسم- طول القطن- محيط الصدر- عرض الصدر- عرض القطن) و تقييم اثر قوة الهجين وقياس التأثيرات المضافة المباشرة والأمية على بعض الصفات الإنتاجية.

- أوضحت اختبارات المعنوية أن تأثير مجموعة التربية وإختبار التضادات المستقيمة على معظم صفات مقاييس الجسم (طول الجسم- طول القطن- محيط الصدر- عرض الصدر وعرض القطن) كانت معنوية عند معظم الأعمار المختلفة.
- اظهر إختبار التضادات المستقيمة تفوق الأرانب البوسكات على الأرانب البلدي الحمراء في صفات مقاييس الجسم وعلى الفترات المختلفة من العمر.
- أدى الخلط بين البوسكات و البلدي الأحمر إلى وجود قوة هجين موجبة ومعنوية لمعظم صفات مقاييس الجسم فيما عدا طول الجسم عند ٨ و ١٤ أسبوع وصفة طول القطن عند عمر ٨ أسبوع و ٤ و ٨ أسبوع لمحيط الصدر و ٤ أسبوع لعرض الصدر و ٨ و ١٢ أسبوع لعرض القطن كانت غير معنوية التأثير.
- كان التأثير التجمعى المباشر معنويا لمعظم صفات مقاييس الجسم عند الأعمار المختلفة و تشير النتائج إلى تفوق ذكور الأرانب البوسكات على الأرانب البلدي الحمراء.
- كان التأثير الأمي المضيف معنوي و موجب لمعظم صفات مقاييس الجسم عند الأعمار المختلفة و تشير النتائج إلى تفوق أمهات الأرانب البوسكات على الأرانب البلدي الحمراء فى بعض الصفات محل الدراسة.