# Factors Affecting Growth Rate of Baladi (Black and Red) Breeds of Rabbits and Their Crosses with New-Zealand Whites

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**Abstract:** Data of the present study were on 837 $F_1$ straight-bred (375) and cross-bred (462) weanling rabbits, produced from a crossbreeding arrangement using three breeds, one exotic, New-Zealand White (NZ) and two local, Baladi-Black (BB) and Baladi-Red (BR). The purposes of the study were to evaluate the heterotic effect of biwkly progeny growth rate (GR) from weaning (at 6 wk of age) up to marketing age (at 16 wk of age), as well as to estimate of the genetic and non-genetic factors affecting this trait. Feed type (pelleted or re-grinded), parity (P; from the 1st till the 3rd) and month of birth (MOB; 1-7), proved significance on GR at most studied ages. Breed group and sex did not affect growth rate significantly except at 6-8 and 8-10 wk of age. Interaction (Breed group X Feed form) affected significantly growth rate at most age intervals except that from 12-14 and 14-16 wk of age. Direct and maternal additive were trivial in improving GR of rabbits using the current crossbreeding plan. Non-additive genetic effects showed better contribution which may enhance better using reciprocal recurrent selection. NZ rabbits were expected to be better dams for post weaning GR trait than either of Baladi breeds and can be used in simple crossing programs incorporating native breeds to produce broiler rabbits.

***Keywords*:** Rabbit, Crossbreeding, feed form, parity, direct additive, maternal additive, heterosis.

## INTRODUCTION

The Animal Production Research Institute, at Dokki, Cairo, Egypt has developed the Baladi Whits, Red and Black rabbits as improved native breeds, which have uniform self-colored pattern and better productivity compared to those unimproved.

Crossbreeding is one of the expeditious existing tools available to breeders for improving several traits in farm animals mostly in the course of utilizing the non-additive genetic variance. Progeny traits (*e.g.* live body weight; daily gain in weight; Growth rate... *etc*) are from the important elements that enormously affect the economical efficiency of the rabbit industry. Crossing Egyptian native rabbit breeds with exotic ones is generally associated with an enhancement in progeny growth and fitness traits (Afifi *et al.*, 1994 and Abdel-Ghany *et al.*, 2000*a*). However, studies on growth traits of rabbits especially for native breeds and under crossbreeding systems in the literature were rather rare.

The objectives of the present work were to evaluate, in a crossbreeding experiment which involves two local rabbit breeds (i.e. Baladi Black, BB and Red, BR) with the exotic New-Zealand White rabbits, the effects of breeding group, sex, maternal and direct additive as well as direct and individual heterosis along with some other non-genetic factors (*i.e.* feed form, month of birth and litter size at birth) on post-weaning growth rate (GR) of rabbits.

## MATERIALS AND METHODS

Data of a crossbreeding experiment using three breeds of rabbits; one exotic (New-Zealand Whites, *NZ*) and two local (Baladi-Black, BB and -Red, BR) from a total of 837 weanling rabbits, 375 straight-bred and 462 cross-bred were used in the investigation. The breeding plan permited the simultaneous production of the pure-bred and the planned crossbred rabbits among the three investigated breeds. In a straight-bred group, bucks 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. Rabbits of each breed group were divided randomly into two groups each were given access to one of two forms of a commercial diet, either crumpled (re-grinded after pelleting) or intact pelleted diet each containing approximately 16.1% crude protein, 2.39% crude fat and 12.8% crude fiber. Feed and water were assigned *ad libitum* all over the experimental period.

Growth rate (GR%) was calculated biweekly from 6 (weaning) till 16 wk of age (marketing) and during the whole period according to the following formula. where GR% at a given period = {100 * [Live body weight at the end of the period (W2)} minus {Live body weight at the start of that period (W1)]} divided by [0.5 * (W2 + W1)]. Statistical analysis for the studied traits was performed using the general linear model procedure (GLM) by Statistical Analysis Systems Institute (SAS, 1999). The linear fixed model adopted for the analysis comprised the effects of breeding group, BG (7 classes); sex (males and females); feed form (pelleted or crumpled); month of birth, MOB (7 classes), parity (from the 1st till the 3rd) and litter size at birth (13 classes); as well as the interactions between BG X sex; BG X feed form and Sex X feed form. Crossbreeding effects (direct and maternal; additive; direct heterotic effect) on post weaning growth rate were derived using a selected set of linear contrasts (Dickerson, 1992). Contrasts identifications, coefficients and divisors are presented in Table 1. Each single degree of freedom contrast was tested for significance with the Student's t-test.

## RESULTS AND DISCUSSION

### Breed groups:

Breed group differences in GR were generally insignificant at various ages except that at 6-8 and 6-16 wk of age (Table 2). In discrepancy with the present results, Abdel-Ghany *et al.* (2000*a*), Chineke, (2005) , Saleh *et al.* (2005), Abou Khadiga *et al.* (2008) and Ouyed and Brun (2008) with miscellaneous breed groups and crosses indicated that breed group effect on growth traits at weaning and post-weaning at variable ages were mostly significant.

Least squares means values of the crosses presented in Table 3 showed no clear superiority trend but mostly in cherish of NZ during the intermittent periods from 8-14 wk of age while in favor of BB for the whole period from 6-16 wk of age. As regard to crosses the pre-eminence was in support of BR X NZ during the whole period from 6-16 wk of age.

In this respect, Khalil (1999), Medellin and Lukefahr (2001) were not able to detect any significant effects for the breed group on post-weaning miscellaneous growth traits. However, Saleh *et al.* (2005) gave evidence that The F1 (baladi black x V line) progeny exceeded both of its reciprocal cross and backcross while Abou Khadiga *et al.* (2008) showed that Line V straight-bred progenies attained the best results while BB straight-bred ones were inferior to all genotypes for all traits.

**Table (1):** Straight-bred differences' and cross-breeding effects' contrasts identifications, coefficients and divisors.

| Identification | Mating groups' Coefficients | | | | | | | Divisor |
|---|---|---|---|---|---|---|---|---|
| | NZW x NZW | NZW x BB | NZW x BR | BB x NZW | BB x BB | BR x NZW | BR x BR | |
| **Pure-bred differences** | | | | | | | | |
| ***NZW vs. BB*** | 1 | 0 | 0 | 0 | -1 | 0 | 0 | 1 |
| ***NZW vs. BR*** | 1 | 0 | 0 | 0 | 0 | 0 | -1 | 1 |
| ***BB vs. BR*** | 0 | 0 | 0 | 0 | 1 | 0 | -1 | 1 |
| **Crossbreeding effects** | | | | | | | | |
| Direct Heterosis ($H^i$): | | | | | | | | |
| ***NZW X BB*** | -1 | 1 | 0 | 1 | -1 | 0 | 0 | 2 |
| ***NZW X BR*** | 1 | 0 | 1 | 0 | 0 | 1 | -1 | 2 |
| **Individual Heterosis:** | | | | | | | | |
| ***NZW X BB*** | -1 | 1 | 0 | 0 | -1 | 0 | 0 | 2 |
| ***BB X NZW*** | -1 | 0 | 0 | 1 | -1 | 0 | 0 | 2 |
| ***NZW X BR*** | 1 | 0 | 1 | 0 | 0 | 0 | -1 | 2 |
| ***BR X NZW*** | 1 | 0 | 0 | 0 | 0 | 1 | -1 | 2 |
| **Direct additive($G^i$)†** | | | | | | | | |
| ***NZW*** | | | | By subtraction* | | | | |
| ***BB*** | -1 | -2 | 1 | 2 | 2 | -1 | -1 | 3 |
| ***BR*** | -1 | 1 | -2 | -1 | -1 | 2 | 2 | 3 |
| **Maternal additive($G^m$)†** | | | | | | | | |
| ***NZW*** | | | | By subtraction* | | | | |
| ***BB*** | 0 | 2 | -1 | -2 | 0 | 1 | 0 | 3 |
| ***BR*** | 0 | -1 | 2 | 1 | 0 | -2 | 0 | 3 |

NZW = New Zealand White; BB = Baladi Black; BR = Baladi Red, * Crossbreeding $effect_{NZW}$ = - (Crossbreeding $effect_{BB}$ + Crossbreeding $effect_{BR}$).
†Dickerson, 1992

**Table (2):** F-values of least squares analyses of variance of factors affecting growth rate from 6 through 16 wk of age in New-Zealand White; Baladi-Black and -Red rabbits and their crosses.

| Sources of variation‡ | df | F-values | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 6-8 wk | 8-10 wk | 10-12 wk | df | 12-14 wk | df | 14-16 wk | df | 6-16 wk |
| **BG** | 6 | 6.94**** | 1.14 | 1.12 | 6 | 1.25 | 6 | 1.22 | 6 | 2.42* |
| **Sex** | 1 | 0.9 | 6.11* | 0.12 | 1 | 0.04 | 1 | 0.35 | 1 | 1.40 |
| **Feed form** | 1 | 29.62**** | 10.10** | 10.63** | 1 | 2.67 | 1 | 3.57 | 1 | 8.43 ** |
| **Parity** | 2 | 3.07* | 7.24*** | 6.78** | 2 | 3.40* | 2 | 0.08 | 2 | 0.60 |
| **MOB** | 6 | 2.99** | 3.25** | 2.82* | 5 | 4.79*** | 5 | 1.56 | 5 | 1.72 |
| **BG X Sex** | 6 | 0.43 | 1.54 | 0.87 | 6 | 2.11 | 6 | 1.29 | 6 | 1.57 |
| **BG X F** | 6 | 3.57** | 3.82*** | 1.21 | 6 | 3.80** | 6 | 1.65 | 6 | 6.24**** |
| **Sex X F** | 1 | 1.88 | 0.44 | 0.37 | 1 | 0.06 | 1 | 1.82 | 1 | 3.35 |
| **Error MS** | | 195.07 | 108.68 | 91.55 | | 66.62 | | 45.18 | | 329.99 |
| **Error df** | | 807 | 718 | 659 | | 348 | | 179 | | 179 |
| **$R^2$** | | 0.147 | 0.141 | 0.09 | | 0.216 | | 0.237 | | 0.37 |

‡BG = Breed group; MOB = Month of birth;
* = Significance at ($P \leq 0.05$); ** = Significance at ($P \leq 0.01$); *** = Significance at ($P \leq 0.001$); **** = Significance at ($P \leq 0.0001$).

**Sex:** Results in Table 2 also demonstrated that the effect of sex was non-significant source of variation on GR of rabbits at all studied age intervals except that at 8-10 wk of age. In this respect, Ahmed, (1997), Khalil (1999), Abdel-Ghany *et al.* (2000*a*), Abdel-Ghany *et al.* (2000*b*) and Chineke, (2005) reported that post-weaning analogous-growth-traits did not prove any significance at most studied ages. Ali, (1998), Saleh *et al.* (2005) and Abou Khadiga *et al.* (2008) with different breed groups of rabbits, detected significant sex effects on body weights. Least squares means of GR (Table 3) illustrated that females slightly transcend males at most age periods and this trend was in consensus with results reported by Abdel-Ghany *et al.* (2000*a*) and Abdel-Ghany *et al.* (2000*b*) on post-weaning analogous-growth-traits. However, Ali, (1998); Saleh *et al.* (2005) and Abou Khadiga *et al.* (2008) showed generally that males were significantly heavier than their contemporary females at different evaluated ages.

**Feed form:** Differences between the effects of crumpled (re-grinded) and pelleted (Table 2) feed forms on GR of rabbits were significant ($P \leq 0.01$ or $P \leq 0.0001$) during the early intermittent periods from 6-12 and the whole profile from 6-16 wk of age.

Yet, Abdel-Ghany *et al.* (2000*a*) reported that feed form was significant source of variation on post-weaning daily gain at most age stages while significance was only detected at 6 and 8 wk of age for post-weaning body weight.

However, least squares means (Table2) were generally in favor of pelleted feed over crumpled. This may be due to that chewing apparatus, enzymatic systems and cecae were developed enough at this age to support the use of un-crumpled feeds judging from GR. This indicated that grinding of pelleted feeds for weaned and growing rabbits is not necessary.

**Parity:** Significant parity effect ($P \leq 0.05$; $P \leq 0.01$ or $P \leq 0.001$) was detected on GR of rabbits at most studied intervals except that from 12-14 and 14-16 wk of age (Table 2). In this respect, Ahmed, (1997) and Ali, (1998), Khalil (1999), Abdel-Ghany *et al.* (2000*a*), Abdel-Ghany *et al.* (2000*b*), Chineke, (2005) Saleh *et al.* (2005) , Abou Khadiga *et al.* (2008) and Ouyed and Brun (2008) reported that parity regularly exerted a significant effect on different growth traits at different evaluated age spans.

Least squares means (Table 3) revealed no clear trend of GR with advance of parity at most studied periods. However, Abdel-Raouf, (1993), Afifi *et al.* (1994), and Khalil (1999) revealed a general trend indicating that live body weight of rabbits at different ages increased with advance of parity till reaching its maximum at certain parity and decreased thereafter. 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 (3):** Least squares means (±SE) of different factors affecting growth rate (GR) from 6 through 16 wk of age in New-Zealand White; Baladi-Black and -Red rabbits and their crosses.

| | Growth rate (GR) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N° | 6-8 wk | N° | 8-10 wk | N° | 10-12 wk | N° | 12-14 wk | N° | 14-16 wk | N° | 6-16 wk |
| **Breed group:** | | | | | | | | | | | | |
| **Straight-bred** | | | | | | | | | | | | |
| ***NZ*** | 206 | 26.73±1.17 | 183 | 24.10±0.93 | 176 | 22.15±0.89 | 111 | 17.43±1.10 | 51 | 15.04±1.36 | 51 | 97.85±3.69 |
| ***BB*** | 97 | 34.88±1.59 | 86 | 22.51±1.27 | 78 | 20.78±1.24 | 52 | 16.37±1.50 | 27 | 13.71±1.94 | 27 | 106.08±5.25 |
| ***BR*** | 72 | 31.86±1.84 | 67 | 22.90±1.42 | 61 | 18.39±1.37 | 41 | 14.69±1.69 | 29 | 16.81±1.75 | 29 | 96.51±4.74 |
| **Cross-bred** | | | | | | | | | | | | |
| **NZ*BB** | 121 | 32.64±1.54 | 111 | 24.03±1.24 | 106 | 21.52±1.19 | 54 | 17.69±1.36 | 33 | 15.84±1.33 | 33 | 105.06±3.60 |
| **NZ*BR** | 171 | 33.51±1.19 | 150 | 25.01±0.97 | 132 | 20.74±0.96 | 44 | 17.23±1.60 | 28 | 16.41±1.65 | 28 | 104.04±4.46 |
| **BB*NZ** | 121 | 28.23±1.58 | 104 | 22.66±1.24 | 93 | 21.28±1.21 | 51 | 19.80±2.31 | 27 | 11.18±2.23 | 27 | 91.00±6.04 |
| **BR*NZ** | 49 | 36.27±2.16 | 47 | 20.82±1.66 | 43 | 21.65±1.59 | 24 | 20.13±1.97 | 13 | 14.57±2.43 | 13 | 113.73±6.57 |
| **Sex** | | | | | | | | | | | | |
| **Males** | 407 | 31.50±0.97 | 361 | 22.10±0.76 | 332 | 21.07±0.76 | 201 | 17.72±1.05 | 105 | 14.49±1.22 | 105 | 100.39±3.32 |
| **Females** | 430 | 32.53±0.92 | 387 | 24.20±0.72 | 357 | 20.79±0.72 | 176 | 17.52±1.04 | 103 | 15.10±1.19 | 103 | 103.69±3.24 |
| **Feed form** | | | | | | | | | | | | |
| **Pelleted** | 360 | 35.28±0.98 | 303 | 24.65±0.77 | 279 | 22.40±0.77 | 215 | 18.63±0.93 | 115 | 16.00±1.17 | 115 | 107.03±3.16 |
| **Crumpled** | 477 | 28.75±0.98 | 445 | 21.65±0.76 | 410 | 19.46±0.75 | 162 | 16.60±1.28 | 93 | 13.59±1.36 | 93 | 97.05±3.68 |
| **Parity** | | | | | | | | | | | | |
| **1st parity** | 421 | 32.49±1.08 | 378 | 25.21±0.85 | 359 | 21.63±0.83 | 241 | 16.08±0.99 | 142 | 14.41±1.03 | 142 | 100.22±2.79 |
| **2nd parity** | 332 | 34.05±1.06 | 295 | 20.92±0.83 | 265 | 18.54±0.83 | 116 | 19.64±1.09 | 57 | 15.05±1.16 | 57 | 98.80±3.15 |
| **3rd parity** | 84 | 29.50±1.90 | 75 | 23.31±1.49 | 65 | 22.63±1.45 | 20 | 17.13±2.37 | 9 | 14.92±3.04 | 9 | 107.10±8.22 |
| **Month of birth** | | | | | | | | | | | | |
| **November** | 104 | 37.82±2.00 | 95 | 24.68±1.57 | 89 | 19.93±1.50 | 64 | 21.17±1.80 | 31 | 17.01±2.14 | 31 | 109.39±5.78 |
| **December** | 129 | 35.96±1.80 | 107 | 23.62±1.42 | 104 | 18.27±1.34 | 78 | 17.95±1.57 | 48 | 13.62±1.73 | 48 | 96.37±4.70 |
| **January** | 187 | 32.86±1.48 | 176 | 20.74±1.15 | 167 | 18.86±1.11 | 123 | 16.20±1.40 | 71 | 14.96±1.79 | 71 | 102.79±4.84 |
| **February** | 123 | 30.42±1.50 | 110 | 21.50±1.19 | 98 | 22.54±1.15 | 47 | 15.14±1.65 | 22 | 17.24±1.90 | 22 | 100.86±5.15 |
| **March** | 190 | 31.21±1.14 | 167 | 20.74±0.90 | 155 | 20.70±0.86 | 54 | 12.95±1.35 | 27 | 12.35±1.57 | 27 | 96.31±4.25 |
| **April** | 79 | 32.19±1.74 | 71 | 22.16±1.37 | 61 | 25.21±1.34 | 11 | 22.30±2.67 | 9 | 13.59±2.55 | 9 | 106.53±6.89 |
| **May** | 25 | 23.66±3.06 | 22 | 28.61±2.44 | 15 | 20.99±2.65 | | | | | | |

[†] Sire breed is preceding dam breed.

**Month of birth (MOB):**

Month-of-birth affected early GR significantly ($P \leq 0.05$; $P \leq 0.01$ or $P \leq 0.001$) at different age intervals except that at 14-16 and the whole plan from 6-16 wk of age (Table 2). Khalil (1999), Abdel-Ghany *et al.* (2000*a*), Medellin and Lukefahr (2001) , Chineke, (2005) and Abou Khadiga *et al.* (2008) reported that regularly MOB or equivalently season effects influenced significantly analogous growth traits of rabbits at different ages, while Saleh *et al.* (2005) reported that post-weaning body weight was insignificantly affected by season at all studied ages.

Least square means listed in (Table 2) illustrated that the highest recorded values for GR were generally at moderate months (*e.g.* November or April) and the lowest were frequently at March. These results were in agreement with those of Abdel-Ghany *et al.* (2000*a*) on body weight and daily gain traits from weaning till marketing ages. However, Belhadi *et al.* (2002) in Algeria and Saleh *et al.* (2005) in Egypt observed that rabbits' weight showed its highest values in winter months but the lowest were in spring.

**Interactions:**

Results for the effect of interactions between BG x Sex and Sex x F (Table 2) on GR were generally insignificant at the majority of the evaluated age periods. This may indicate parallel response of males and females for different breeding groups or feed type.

However, the interactions between BG x Feed form were significance ($P \leq 0.01$; $P \leq 0.001$ or $P \leq 0.0001$) at most age periods except that from 10-12 and 14-16 wk of age. This may indicate dissimilar response of different breeding groups to the effect of feed form. This probably means that conclusion on using re-grinded feed would be different from one breeding group to another.

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

Estimates of direct heterosis ($H^i$) for post weaning GR (Table 4) were positive for the cross between NZ and BB only at 8-10 and 12-14 wk of age, while the cross between NZ and BR were fundamentally positive except that at 8-10 and 14-16 wk of age. However, these findings lead to state that crossbreeding exploiting Baladi red rabbit breeds with NZ was generally associated with heterotic effect leads to an improvement in GR during most studied periods. Data also revealed that the magnitude of $H^i$ is age dependent. 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. This non-additive genetic effect is expected to enhance more using reciprocal recurrent selection between the breeds in the current crossbreeding plan.

The present results were in agreement with those reported by Abdel-Ghany *et al.* (2000*a* &*b*); Medellin and Lukefahr, (2001), Saleh *et al.* (2005) and Abou Khadiga *et al.* (2008) on post weaning growth traits using miscellaneous rabbit groups.

**Individual heterosis:**

Results illustrated in Table 4 revealed that there was a slight insignificant superiority trend of NZ bucks over BB and Br rabbits. However crosses sired by BR significantly surpassed others sired by NZ or BB at 6-8; 12-14 and 6-16 wk of age. These results may suggest the use of NZ rabbits as sire breed with NZ as dam breed in the crossbreeding strategy designated to establish native broiler rabbits especially with the NZ well known maternal effects.

**Table (4):** Linear functions, (±Standard Error, SE) of crossbreeding effects regarding growth rate (*GR)* at 8, 10, 12 and 14 wk of age in New-Zealand White (*NZ*); Black- (BB) and Red-Baladi (BR) rabbits and some of their crosses.

| Estimate | Growth rate (GR) at | | | | | |
|---|---|---|---|---|---|---|
| | 6-8 wks | 8-10 wks | 10-12 wks | 12-14 wks | 14-16 wks | 6-16 wks |
| **Direct Heterosis ($H^i$):** | | | | | | |
| **NZ – BB** | -0.37±1.41 | 0.04±1.12 | -0.06±1.06 | 1.84±1.49 | -0.86±1.50 | -3.93±4.06 |
| **NZ – BR** | 5.59±1.54*** | -0.58±1.19 | 0.92±1.13 | 2.61±1.40 | -0.43±1.56 | 11.70±4.23** |
| **Individual heterosis‡** | | | | | | |
| **NZ- BB** | 0.91±0.90 | 0.36±0.72 | 0.02±0.68 | 0.39±0.77 | 0.73±0.82 | 1.54±2.23 |
| **BB – NZ** | -1.29±0.86 | -0.32±0.68 | -0.09±0.65 | 1.45±1.16 | -1.59±1.08 | -5.48±2.92 |
| **NZ- BR** | 2.10±0.78** | 0.75±0.62 | 0.23±0.59 | 0.58±0.84 | 0.24±0.88 | 3.42±2.39 |
| **BR – NZ** | 3.48±1.14** | -1.34±0.88 | 0.68±0.83 | 2.03±0.96* | -0.67±1.15 | 8.27±3.12** |
| **Direct additive($G^i$):** | | | | | | |
| **BB** | -0.10±1.46 | -0.13±1.15 | -0.08±1.11 | 0.75±1.55 | -2.98±1.60 | -5.00±4.32 |
| **BR** | 3.00±1.61 | -1.95±1.25 | -1.02±1.20 | -0.18±1.52 | 1.46±1.66 | 5.63±4.49 |
| **Maternal additive($G^m$):** | | | | | | |
| **BB** | 2.89±1.17* | -0.36±0.92 | 0.34±0.89 | -0.33±1.39 | 1.87±1.33 | 9.45±3.59** |
| **BR** | -2.48±1.28 | 1.75±1.00 | -0.5±0.95 | -0.92±1.28 | -0.24±1.42 | -8.36±3.83* |

NZ = New-Zealand White; BB = Baladi Black and BR = Baladi Red;

‡ Sire breed is preceding dam breed

* = Significance at ($P \leq 0.05$); ** = Significance at ($P \leq 0.01$); *** = Significance at ($P \leq 0.001$).

In this respect, Medellin and Lukefahr, (2001) reported that individual heterosis positively influenced average daily gain and market weight for Altex-sired compared to NZ rabbits.

**Direct and Maternal additive effect ($G^i$ and $G^m$):**

Results of $G^i$ and $G^m$ at the present study were mostly insignificance (Table 4). $G^i$ indicates the additive contribution of a given breed used in a crossbreeding plan (Abdel-Ghany *et al.,* 2000*a* &*b*). There was a negative $G^i$ trend of both Baladi rabbits at most studied age intervals (indicating insignificantly positive trend for NZ rabbits). These results may lead us to doubt the assumption that NZ rabbits are better for post weaning GR than either of Baladi breeds to be used in simple crossing programs incorporating these breeds. Results presented in Table 4 gave an evidence of positive and significant ($P \leq 0.05$ or $P \leq 0.01$) of $G^m$ effects in case of BB rabbits at 6-8 and the whole period from 6-16 wk of age. Data also revealed a negative insignificant trend of BR rabbits in their maternal additive effect but significantly along the whole period from 6-16 wk of age. These results may indicate that if selection should be directed to mothering ability to produce native broiler rabbits, NZ is ranked first followed by BB is expected to be the chosen breed.

McNitt and Lukefahr, (1996) and Abdel-Ghany *et al.* (2000*a*), Saleh *et al.* (2005) and Abou Khadiga *et al.* (2008) reported positive and significant effects of $G^m$ effects on some related growth traits. On the contrary, Khalil, (1999) reported that $G^m$ effects on post-weaning body weight were non-significant and showed that maternal ability of recent domesticated hare Gabli rabbits was slightly higher than that of NZ breed.

Maternal effect ($G^m$) consists mainly from additive maternal and cytoplasmic inheritance. Denoting $G^m$ in terms of complimentarily effect, certain crosses may show much more $G^m$ than others depending upon the extent to which the crossed populations differ in reproductive performance along with production characters. Therefore, this type of effect relies on the direction of the crossing (Ahmed, 2003).

## CONCLUSION

Direct and maternal additive were trivial in improving GR of rabbits using the current crossbreeding plan. Non-additive genetic effects showed better contribution which may enhance better using reciprocal recurrent selection. For sake of indigenous broiler rabbit hybrids, NZ rabbits are better dams for post weaning GR trait than either of the Baladi breeds.

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# العوامل المؤثرة على معدل سرعة النمو لنوعى لأرانب البلدى (الأسود والأحمر) وخلطانها مع النيوزيلندى الأبيض

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البيانات الحالية مأخوذة على صفة معدل سرعة النمو كل أسبوعين بدءا من الأسبوع السادس وحتى الأسبوع السادس عشر، على ٨٣٧ خلفة أرانب مفطوم منها ٣٧٥ أرنب نقــى و ٤٦٢ أرنب خليط ناتجة من التهجين بين نوعين من الأرانب المحلية وهى البلدى الأسود والأحمر ونوع قياسى هو النيوزيلندى الأبيض. هدفت الدراسة إلى تقييم التأثير التهجين (التأثير المباشر والأمى المضيف) وكذا قوة الهجين المباشرة والفردية لصفة معدل سرعة النمو كل أسبوعين وأيضا التأثيرات غير الوراثية (جنس الخلفة وشكل العلف المقدم وترتيب البطن وشهر الميلاد وحجم الخلفة عند الميلاد) من الفطام حتى ١٦ أسبوع من العمر (عمر التسويق).

وجد أن شكل العلف المقدم وترتيب البطن وشهر الميلاد قد أظهر تأثيرا معنويا على صفة معدل سرعة النمو فى أغلب الأعمار المدروسة. كما وجد أيضا أن تأثيرمجموعة التربية كان غير معنوى على صفة معدل سرعة النمو فى كل الأعمار المدروسة ما عدا خلال الفترات من ٦-٨ أسبوع ، ٦-١٦ أسبوع من العمر على الصفة محل الدراسة. هذا وقد أثر جنس الخلفة بصورة غير معنوية على صفة معدل سرعة النمو عند كل الأعمار المدروسة ما عدا خلال الفترة من ٨-١٠ اسابيع من العمر . وقد كان تأثير التفاعل بين مجموعة التربية وشكل العلف المقدم على صفة معدل سرعة النمو معنويا فى كل الأعمار المدروسة ما عدا خلال الفترات ١٢-١٤ و ١٤-١٦ أسبوع من العمر.

بالنسبة لتأثير قوة الهجين المباشرة فقد كانت وموجبة لصفة معدل سرعة النمو فى أغلب الأعمار المدروسة. والتأثير الأمى التجمعى لسلالة البلدى الأحمر لصفة معدل سرعة النمو كان موجبا ومعنويا عند أغلب الأعمار محل الدراسة.