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Assessing the Genetic Response of Crossing on Post-Weaning Growth Traits in Rabbits

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Abstract

THIS STUDY conducted a crossbreeding experiment involving Gabali bucks (GB) and New Zealand White (NZW) rabbits to assess the impact of crossbreeding on post-weaning body weights at 4, 6, 8, 10, and 12 weeks of age. Additionally, daily gain in weight (DG) was computed at intervals of 4-6, 6-8, 8-10, and 10-12 weeks. The crossbreeding genetic parameters (direct additive, maternal effects, and direct heterotic effect) of different traits were estimated. Significant differences ($P \leq 0.001$) between genetic groups were observed for all BW and DG4-6. The estimates of direct additive genetic reveal that GB rabbits are significantly superior ($p<0.01$) to NZW rabbits in post-weaning growth body weight (BW6, BW8, BW10) traits at most ages and DG_{4-6}, with an increase in BW representing a percentage ranging from 8 to 16.8%, and for DG ranging from 3.2 to 28.1%. The estimates of maternal effect (G^M) reveal that the GB breed had a preference significant G^M ($p<0.01$) compared with the NZW breed at BW6(78.62g) and DG4-6(4.28 g/d), with an increase represented percentages of 9.9 and 19.54% for BW6 and DG4-6, respectively. The NZW breed had a preference G^M ($p<0.01$) for DG traits in the last three intervals (DG6-8, DG8-10, and DG10-12), with percentages ranging from 8.2 to 17.6%. The analysis revealed positive and significant ($P \leq 0.001$) effects of direct heterosis, ranging from 13.2 to 28.5% for BW traits and ranging from 6.2 to 27.9% for DG traits. Crossbreeding GB and NZW rabbits can improve post-weaning growth and contribute to creating high-growth lines for smallholder breeders.

Keywords: Body Weight, Crossbreeding, Heterosis, Maternal Effect, Rabbits.

Introduction

In Egypt, rabbits are bred to provide protein and generate income for families. However, this has resulted in a decline in the economic value of rabbits because most of the rabbit production is done by small producers, some of whom may not be adequately skilled in raising rabbits. Therefore, the rabbit farming industry must expand to meet current demands, requiring small breeders to shift their objectives and practices [1,2].

There are notable differences in the fattening period, carcass characteristics, and the quality of meat among rabbit breeds. In commercial rabbit breeding, crossbreeding between medium and large breeds can be a beneficial option, as it can have a positive impact on the quantity and quality of the final product [3-5].

Benefiting from breed complementarity, maximizing heterosis effects, increasing fertility, improving fitness, and avoiding the negative consequences of inbreeding depression are the primary goals of crossbreeding livestock animals [6-8].

In comparison to other livestock, rabbits possess unique characteristics, including a short generation interval, high production potential, rapid growth rate, and most importantly substantial genetic diversity

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among strains, relative to genetic variation within breeds [9,10]. Therefore, crossbreeding systems can be employed in rabbits to enhance production through the utilization of complementary breed effects, heterosis and the ability to compare the performance of different breeds and their crosses [11,12].

In most rabbit breeding programs, sire lines are selected based on post-weaning daily weight gain or weight at the end of the fattening period. This is because heavier market weight is crucial for profitability in rabbit farms, as it allows for selling more kilograms of rabbit and increasing profit [13-15].

Various genetic projects and experiments were conducted under Egyptian conditions to exploit genetic variation through crossbreeding between local breeds and different standard exotic breeds to enhance the most important economic traits [16-19]. Most previous studies were accompanied by positive results of significant heterosis effects, as well as direct additive genetic and maternal effects, on the growth performance of offspring at various ages, specifically regarding body weights and gains at different intervals [20].

In most instances of crossing between Gabali and exotic breeds or synthetic lines of rabbits, positive direct heterosis has been observed in traits such as body weight, daily gain, and survival from weaning to marketing age [15,16,21].

Considering this, the main objectives of this study are to evaluate the effects of crossbreeding, including direct additive genetic, maternal, and direct heterosis effects, on post-weaning growth traits, through a simple crossbreeding experiment involving Gabali bucks (GB) and New Zealand White (NZW) rabbits does.

Experimental

Location

The study was conducted at the rabbitry of the Faculty of Agriculture, Al-Azhar University in Nasr City, Cairo, Egypt, and lasted for two consecutive years.

Breeding plane

The breeding plan allowed for the simultaneous production of three genetic groups: two purebred Gabali (GB) and New Zealand White (NZW) rabbits, as well as one F1 crossbred (½GB½NZW) offspring result of mating a GB buck with NZW does.

Management

Male and female rabbits were kept separately in wire cages of a standard size in a pyramidal rabbit battery. The battery was arranged in two rows with service passageways. Each male rabbit in the purebred groups was randomly assigned to mate with 3-5 female rabbits at sexual maturity, (6 months). However, they were not allowed to mate with their full siblings, half-siblings, or their offspring. The female rabbits were checked for pregnancy ten days after mating. If they did not conceive, they were returned to their assigned male rabbit for re-mating. On the 27th day of pregnancy, nest boxes were provided with rice straw. The litter was inspected 12 hours after giving birth, and any dead bunnies were removed from the nest during daily morning checks. When the young rabbits were 4 weeks old, they were weaned, ear-tagged, sexed and transferred to standard progeny wire cages, which were equipped with feeding hoppers and drinking nipples, by 3-4 rabbits per cage. During the experimental period, breeding animals were fed ad libitum with a pelleted commercial ration containing 18% crude protein, 11.5% crude fiber, and 2560 kcal/kg feed in digestible energy.

Traits studied

Post-weaning traits including both of the individual body weights (BW) of 1654 of rabbits recorded at 4 (BW4), 6 (BW6), 8 (BW8),10 (BW10), and 12 weeks (BW12) of age, expressed in grams(g), along with the daily gain in weight (DG) computed at intervals of 4-6 (DG4-6), 6-8 (DG6-8), 8–10 (DG8-10), and 10-12 (DG10-12)of age, expressed in grams /day(g/d).

Statistical analyses

To detect the effect of the genetic group and estimate the least squares mean (LSM) of each genetic group, pooled data of individual body weight and daily gain were analyzed using the general linear model (GLM) procedure SAS [22] according to the following statistical model.

$Y_{ijklmn} = \mu + G_i + P_j + y_k + Se_l + Sx_m + e_{ijklmn}$……
Where:

Y_{ijklmn} = the observation on the ijklmnth growth trait; μ = overall mean, G_i = random effect of ith breed group; P_j = the fixed effect of the jth parity(the parity which the individual was born); Y_k = the fixed effect of the kth year; Se_l=the fixed effect of the lth season; Sx_m=the fixed effect of the mth sex, and e_{ijklmn} =a random deviation particular to growth trait and assumed to be independently randomly distributed with zero means and variances σ^2e.

The estimated least-squares means used as input data for the program package CBE, version 4.0 Wolf [23] used for estimating the crossbreeding genetic parameters (direct additive, maternal effects, and direct heterotic effect) of different traits. The estimation was conducted by weighted least squares means.

However, coefficients of expected contribution for genetic effects in the three genetic groups computed by Dickerson [24] are illustrated in Table (1).

The following linear contrast of mating type least squares means were computed to quantify differences attributable to the crossbreeding genetic parameters as follows:

Direct additive genetic effects: GI= GI GB - GI NZW

Maternal effects: GM= GM GB – GM NZW

Direct heterosis (units): HI=[(½GB½NZW) - ½(GB) -½(NZW)]

Results and Discussion

Means and variation

Table 2 presents the post-weaning performance along with their corresponding standard deviations (SD) and coefficients of variation (CV%), for each genetic group.

Means of BW and DG of some breeds of rabbits adapted to Egyptian conditions recorded at different ages are within the ranges reported in the Egyptian literature by [7,17-19,24,25].

Based on estimates of CV% of growth traits, it appears that the CV% across all genetic groups tend to decrease as rabbits age. This suggests that young rabbits are more susceptible to non-genetic maternal factors like lactation, mothering ability, litter size, and weight, which tend to decline over time. Moreover, the combination of these non-genetic maternal factors also plays a role in this outcome [25,26].

The estimates for CV% of BW traits ranged from 12.4% to 28.4%. For DG traits, CV% fell within the moderate to high range between 24.2% and 35.4%.

The CV% for DG was consistently higher than that for BW across all intervals. This indicates that phenotype selection may be a more accessible method of enhancing such traits, especially under commercial systems.

Genetic group means

Genetic group least-square means (GLM) of post-weaning growth (BW and DG) traits are given in Table (3). Differences between genetic groups were significant ($P \leq 0.001$) for all BW and DG during the intervals of 4-6 (DG4-6). While it was significant ($P \leq 0.05$ and $P \leq 0.01$) at the age intervals of 6-8, 8-10 and 10-12.

According to the GLM, the F1 showed superiority over the mean of its purebred parents in terms of all BW and most DG, especially, in average weight of the 12-week (1945 gm) with evidence for significant positive heterosis noted for growth traits (18.3%, table 6).

Crossbreeding experiments conducted by Abou-Khadiga [24], Gharib [27], Medellin and Lukefahr [20], and Shehab El-Din [19] demonstrated that crossbreeding among breeds have a positive impact on body weight and daily gain at different ages and stages of growth. So, from this standpoint, it could be concluded that the breeders would get better meat production by applying a simple crossing between GB bucks and NZW does.

Direct additive genetic effects (G^I)

Table 4 displays the GLM for direct additive genetic effects (GI) and their percentages for post-weaning growth traits. These estimates reveal that GB sires are significantly superior ($p<0.01$) to NZW sires in post-weaning growth BW traits at most ages (BW6, BW8, BW10) and DG4-6. However, NZW sires outperformed GB of BW12, DG6-8 and DG10-12.

The increase in BW, ranging from 111.99 to 133.99 g, represents a percentage increase ranging from 8 to 16.8%, and for DG ranging from 0.69 to 6.9 g, represents a percentage increase ranging from 3.2 to 28.1%. According to current results, the GB sires outperform the NZW sires in terms of growth traits due to their GI. Therefore, it is highly recommended to incorporate the sires of the GB breed into crossbreeding programs to improve growth performance.

In this respect, an experiment conducted by Ahmed [28] reported that GB rabbits had a higher estimate of GI compared with NZW rabbits. Specifically, GB rabbits had a significant advantage of 7.07%, 15.33%, 30.88%, and 61.61% for BW at 6, 8, 10, and 12 weeks of age, and a remarkable advantage of 2.13%, 20.60%, 24.57%, and 49.10% for DG at 4-6, 8-10, 10-12, and 4-12 weeks of age.

Moreover, Sanad *et al.,* [21] in a crossbreeding experimental among GB buck and Hyplus line does reveal that the GB breed displayed a significant advantage ($p<0.01$) over Hyplus lines, with a weight of 125-450 g (22.1-32.8%) and a DG increase of 0.90-7.8 g (3.7-38.1%). Iraqi et al., [10] noted that the GB breed was superior to the V -line for GI for both BW (BW8 and BW12) and DG traits (DG4-8 and DG8-12), their estimates presenting an advantage in favour of the GB breed ranged from 5.2 to 21.3%.

Maternal effects (G^M)

Table 5 displays the GLM for maternal effects (GM) and their percentages for body weights and daily weight gains.

The GB dams had a preference significant GM ($p<0.01$) compared with the NZW dams at

BW6(78.62g) and DG4-6(4.28g/d), with an increase represented percentages of 9.9 and 19.5.4% for BW6 and DG4-6, respectively. The NZW dams had a preference GM ($p<0.01$) for DG traits in the last three intervals (DG6-8, DG8-10, and DG10-12), with preference ranging from 1.88 to 3.97 g, with percentages ranging from 8.2 to 17.6%.

Maternal effects for the rest of the studied traits were insignificant, although the GB dams preferred BW10 (13.63 g) and the NZW dams preferred BW12 (128.3 g).

Negative GM (Table 5) for most traits, indicates a preference for kittens that are mothered by the NZW dams rather than the GB dams. Thus, when considering these specific traits, it is recommended that NZW dams be included in crossbreeding programs to take full advantage of maternal capabilities.

In a crossbreeding experiment between NZW and GB rabbits, Abdel-Aziz [29] reported that GM positively ($p<0.01$) influenced post-weaning growth traits, with a preference for GB dams. Abou-Khadiga et al., [17] found that the V-line dams significantly outperformed the Baladi Black rabbits in a crossbreeding experiment, with exhibited percentages of GM, by 4.4 and 5.9% of BW at 8 and 12 weeks, respectively. Moreover, Sanad et al., [21] reported that the estimates of GM were significantly ($p<0.01$) in favor of the GB breed by 125–481.5g with percentages ranging from 22 to 34.8% for BW growth traits (from 5 and 13 weeks), and by 1.1–8.9 g for DG with percentages ranging from 4.7 to 43.4%, respectively.

In terms of the complementarity effect and response for crossbreeding among breeds, certain crosses may show much more maternal effect than others depending on the differences in reproductive and production performance between the purebreds involved in crossbreeding. These differences in maternal effect refer to the additive maternal and cytoplasmic inheritance for each breed [30].

Direct Heterosis (H^I)

Table 6 represents estimates of direct heterosis (HI) (calculated in actual units and as percentages) for different traits. These estimates indicated that crossbreeding between GB and NZW rabbits was usually associated with the existence of heterosis effects on all post-weaning growth traits (except at DG10-12). HI estimates were positive and had significant effects ($P\leq0.001$) ranging from 13.2 to 28.5% for BW and ranging from 6.2 to 27.9% for DG. The F1 combination (GG x NZW) showed superiority over the mean of its purebred parents in all traits. Similar heterotic effects were evident in most of the possible crossbred combinations for growth traits [7,8,16,17,19,24,28,31,32]. Most studies under Egyptian conditions or in the Arab region indicated that the BW and DG of crossbred rabbits obtained from mating sires of native local breeds with dams from exotic ones surpassed those of crossbred ones obtained from the reverse mating and observed the presence of heterotic effects. This could be explained on the basis that the exotic dams (e.g., NZW, V-Line) were superior in their mothering and milking abilities to the dams of local Egyptian breeds. In a study conducted by Iraqi et al., [16] crossbreeding between Sinai GB buck and V- line rabbits resulted in HI estimates ranging from 33 to 94 g for BW, and for DG from 4 - 8 and 8- 12 weeks of age showed estimates of 2.2 and 1.4 g, respectively. Abou-Khadiga et al., [24] reported positive percentages of HI in a crossbreeding experiment involving Baladi black buck and V-line rabbits. The percentages for HI ranged from 8.0 to 10.8% for BW and from 7.0 to 11.8% for DG. Also, Youssef et al., [18] reported positive HI estimates in a crossbreeding experiment involving Baladi black buck and V-line rabbits. Their estimates ranged from 4.9 to 16.7% for BW and from 14.4 to 29.5% for DG. Khalil and Al-Homidan [30] reported significantly positive HI when crossing Saudi GB buck with V-line rabbits. The HI ranged from 4.5 to 5.4% for BW and 6.6 to 9.6% for DG. Shehab El-Din [19] reported positive percentages of HI in a crossbreeding experiment involving Baladi red and V-line rabbits. The estimates ranged from 3.60 to 10.91 for BW. For DG traits the estimates ranged from 0.78 to 18.35. Most of the studies mentioned above indicated that the reason for those improved results of crossbreeding may be due to the existence of non-additive inter-breed genetic effects. The F1 combination (GB x NZW) showed superiority over the mean of its purebred parents in average weight of the 12-week (301 gm) with evidence for heterosis percentage (18.3%). Hence, the breeders would get better meat production by applying a simple crossing between GG bucks and NZW does. Farg *et al.,* [33] reported that to improve rabbit growth rate and save time and cost, crossbreeding Flemish Giant as sire breed and NZW as dam breed is recommended. Abd El-Latif *et al.,* [34] noted that crossbreeding between the Alex line (paternal) and the V-line (maternal) may be beneficial for the growth, feed intake, survivability, and economics of rabbit breeding.

Conclusions

The crossbreeding of Gabali rabbits adapted to the native environment with the NZW breed yields favorable outcomes in post-weaning growth traits. In Egypt, the preference is for male Gabali rabbits as sires and female NZW rabbits as dames to initiate novel rabbit lines showcasing enhanced growth performance. The resulting F1 offspring from these crosses can be accessible to smallholder breeders, who dominate the rabbit industry in Egyptian conditions and commonly opt for breeding hybrid rabbits. Nevertheless, additional research is essential to assessing the performance of the F1 generation under diverse farm conditions, encompassing varying economic and rearing situations.

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Ethical Considerations

This study was conducted by ethical guidelines for animal experimentation, and all procedures were approved by The Institutional Animal Care and Use *Committee (ARC-IACUC) Agricultural Research Centre Approval Number ARC ABRI 10 24*

Conflicts of interest

There are no conflicts to declare.

Funding statement

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Author`s contributions

The authors contribute equally in this work.

TABLE 1. Genetic groups of rabbits with their sires and dams and coefficients of the matrix relating genetic group means of rabbits with crossbreeding parameters.

RABBIT GENETIC GROUP	SIRE	DAM	MEAN	COEFFICIENT OF THE MATRIX				
				G^I		G^M		H^I
				GB	NZW	GB	NZW	
Gabali (GB)	GB	GB	1	1	0	1	0	0
New-Zealand (NZW)	NZW	NZW	1	0	1	0	1	0
F_1(½GB½NZW)	GB	NZW	1	0.5	0.5	0	1	1

G^I =direct additive genetic effects, G^M =maternal genetic and H^I=direct heterosis; GB= Gabali breed; NZW: New-Zealand breed; F_1 crossbred (GB ♂ X NZW ♀)

TABLE 2. Actual means, standard deviations (SD) and coefficients of variation (CV %) for post-weaning growth traits in different genetic groups.

Traits	Gabali				New Zealand				F_1 *			
	No.	Mean	SD	CV %	No.	Mean	SD	CV %	No.	Mean	SD	CV %
Body weight(g):												
BW_4	198	505.9	113.1	22.4	1041	492.7	123.5	25.1	415	565.6	160.8	28.4
BW_6	195	878.4	175.4	20.0	1039	745.2	159.2	21.4	409	896.2	199.6	22.3
BW_8	192	1219.2	201.5	16.5	1027	1081.8	199.7	18.5	401	1295.2	252.8	19.5
BW_{10}	185	1502.2	235.8	15.7	1005	1364.5	218.4	16.0	399	1697.2	297.5	17.5
BW_{12}	179	1817.6	225.5	12.4	985	1696.4	246.5	14.5	372	2009.4	296.4	14.8
Daily gain (g/d):												
DG_{4-6}	195	25.6	8.5	33.2	1039	18.04	6.1	34	409	23.6	8.4	35.4
DG_{6-8}	192	23.9	7.1	29.5	1027	24.04	7.2	30.02	401	28.5	9.3	32.7
DG_{8-10}	185	20.5	5.6	27.3	1005	20.19	5.5	27.3	399	28.7	9.2	31.9
DG_{10-12}	179	21.5	5.8	27.2	985	23.71	5.7	24.2	372	22.3	6.7	30.07

* F_1 crossbred (GB ♂ X NZW ♀)

TABLE 3. Generalized least square means (GLM) ± standard errors (SE) of genetic group for post-weaning growth traits.

TRAITS	Purebreds		F_1	SIG.
	GB	New-Zealand		
Body weight(g)				
BW_4	498 ± 9.7	491 ± 6.9	569 ± 9.3	***
BW_6	864 ± 13.6	730 ± 8.2	902 ± 11.9	***
BW_8	1182 ± 20.7	1059 ± 14.7	1440 ± 20.8	***
BW_{10}	1461 ± 32.1	1349 ± 22.4	1657 ± 32.7	***
BW_{12}	1622 ± 57.3	1666 ± 33.9	1945 ± 51.5	***
Daily gain(g/day)				
DG_{4-6}	25.1 ± 0.6	18.9 ± 0.4	23.8 ± 0.5	***
DG_{6-8}	23.4 ± 0.8	25 ± 0.52	28.8 ± 0.7	*
DG_{8-10}	21.7 ± 0.9	21 ± 0.5	27.3 ± 0.6	**
DG_{10-12}	20.5 ± 1	24.8 ± 0.6	20.04 ± 0.7	**

*=P≤0.05, **=P≤0.01 and ***=P≤0.001.

TABLE 4 .Estimates of direct additive effect (G^I) and their standard errors (SE) for post-weaning growth traits.

TRAITS	G^I		SIG.
	Unit ±SE	%	
Body weight(g)			
BW_4	6.99 ± 1.9	1.4	NS
BW_6	133.99 ± 15.88	16.8	**
BW_8	122.99 ± 25.38	11.0	**
BW_{10}	111.99 ± 39.14	8.0	**
BW_{12}	-43.99 ± 66.57	-2.7	NS
Daily gain(g/day)			
DG_{4-6}	6.19 ± 0.72	28.1	**
DG_{6-8}	-1.6 ± 0.95	-4.5	NS
DG_{8-10}	0.69 ± 1.02	3.2	NS
DG_{10-12}	-4.29 ± 1.16	-19.0	**

G^I%= [G^M in units/ Average sum of the two purebreds] ×100; NS =not significant, and **p<0.01.

TABLE 5. Estimates of maternal effect (G^M) and their standard errors (SE) for post-weaning growth traits.

TRAITS	G^M		SIG.
	Unit ± SE	%	
Body weight(g)			
BW_4	-20.69 ± 7.11	-4.2	NS
BW_6	78.62 ± 15.1	9.9	**
BW_8	-3.90 ± 2.9	-0.3	NS
BW_{10}	13.63 ± 7.0	1.0	NS
BW_{12}	-128.34 ± 63.9	-7.8	NS
Daily gain(g/day)			
DG_{4-6}	4.28 ± 0.67	19.5	**
DG_{6-8}	-2.95 ± 0.90	-8.2	**
DG_{8-10}	-1.88 ± 0.97	-8.8	**
DG_{10-12}	-3.97 ± 1.09	-17.6	**

G^M%= [G^M in units/ Average sum of the two purebreds] ×100.
NS =not significant, and **p<0.01.

TABLE 6. Estimates of heterosis (H^I) effects and their standard errors (SE) for post-weaning growth traits.

TRAITS	H^I		SIG.
	UNIT ± SE	%	
Body weight(g)			
BW_4	74.5 ± 11.04	15.1	**
BW_6	105.5 ± 14.30	13.2	**
BW_8	319.5 ± 24.36	28.5	**
BW_{10}	252.0 ± 38.10	17.9	**
BW_{12}	301.0 ± 61.32	18.3	**
Daily gain(g/day)			
DG_{4-6}	1.80 ± 0.72	8.2	**
DG_{6-8}	4.6 ± 0.95	12.8	**
DG_{8-10}	5.95 ± 1.02	27.9	**
DG_{10-12}	1.39 ± 1.16	6.2	NS

H^I%= [H^I in units/ Average sum of the two purebreds] ×100; **p<0.01, and NS =not significant

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تقييم الاستجابة الوراثية للخلط على صفات النمو بعد الفطام في الأرانب

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تجربة خلط بسيط أُجْرِيَت بالمزرعة البحثية للأرانب بقسم الإنتاج الحيواني – بكلية الزراعة بالقاهرة جامعة الأزهر- خلال عامين متتالين، وذلك لتقييم الاستجابات الوراثية من الخلط (قوة الهجين، والتأثير الإضافي المباشر والأمي)، حيث شملت التجربة ثلاث مجموعات وراثية من الأرانب مجموعتين نقيتين وهما الجبلي والنيوزلندي الأبيض، ومجموعة خليطة ناتجة من تزاوج ذكور الجبلي وإناث النيوزلندي. شملت الدراسة صفات النمو والتي تضم أوزان الجسم بعد الفطام (4 أسابيع)، 6، 8، 10، و12 أسبوعاً وكذلك معدلات الزيادة الوزنية اليومية خلال تلك الفترات. كانت الاختلافات بين المجموعات الوراثية عالية المعنوية لمعظم الصفات محل الدراسة مع تفوق ملحوظ للمجموعة الوراثية الخليطة مقارنة بالمجموعتين النقيتين. أظهرت النتائج المتعلقة بالتأثير الإضافي المباشر أن سلالة الأرانب الجبلي ذات أفضلية معنوية مقارنة بالنيوزلندي الأبيض لصفات وزن الجسم عند عمر 6، 8 و10 أسابيع وكذلك معدل الزيادة الوزنية اليومية في الفترة من 4-6 أسابيع وتراوح معدل الزيادة في وزن الجسم من 111.9-133.9 جم بما يمثل نسبة زيادة تتراوح من 8-16%، وبلغت الزيادة الوزنية اليومية من 0.69 - 6.9 جم/يومياً بما يمثل زيادة تراوحت من 3.2 -28.1%، في حين أظهرت المتوسطات تفوق لسلالة النيوزلندي عند وزن التسويق وخلال الفترتين من 6 - 8، و10-12 أسبوعاً. كشفت تقديرات التأثير الأمي أن سلالة الجلبي لديها ذات أفضلية معنوية مقارنة بسلالة النيوزلندي الأبيض في عمر 6 أسابيع بمعدل 78.62 جم، وزيادة وزنية في الفترة من 4 - 6 أسابيع بمقدار 4.28 جم/يومياً مع زيادة تمثل نسب 9.9 و 19.54٪ لكلتا الصفتين على التوالي كان للأمهات من سلالة النيوزلندي تفضيل معنوي لصفات معدل الزيادة الوزنية اليومي في آخر ثلاث فترات (6 - 8، و8 - 10، و10-12)، بنسب تتراوح من 8.2 إلى 17.6. أظهرت المجموعة الخليطة تقديرات معنوية لقوة هجين، تتراوح من 13.2 إلى 28.5٪ لصفات وزن الجسم تتراوح من 6.2 إلى 27.9٪ لصفات معدل الزيادة الوزنية اليومي.

أظهرت النتائج الحالية أن اتباع نظام التزاوج بالخلط بين ذكور الجلبي وإناث النيوزلندي ذا أثر إيجابي أدى الى تحسن معنوي لصفات النمو بعد الفطام يمكن البناء على تلك النتائج بالعمل على إنتاج خط محسن أو توفير الجيل الأول الخليط لأصحاب الحيازات الصغيرة من مربى الأرانب مع ضرورة إجراء مزيد من الأبحاث لتقييم أداء المجموعة الخليطة في ظل ظروف رعائية وإقتصادية متباينة.

كلمات مفتاحية: الخلط، أرانب الجبلي، قوة الهجين، وزن الجسم