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IMPACT OF CROSSING BETWEEN GABALI AND V–LINE RABBITS ON THE PRE-WEANING TRAITS BY USING TRIDIAGONAL AND GENETIC MERIT METHODS.

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ABSTRACT: This study was done inside an assignment that intended to break down options and strategies for the progression of a rabbit line by using two pure breeds (V-line (V), and Gabali (G)). Records of 448 packs delivered by 45 does and 16 bucks were utilized to estimate covariance, Heritability (*h^2*), genetic and phenotypic correlations, and breeding values of litter traits were evaluated in composite of crossbreeding arrangement of ten mating groups. The initial five groups comprise of (G♂ X V♀) and reciprocal crosses (V♂ X G♀) for the other five groups. Each buck was represented as a sire to all litters in each group to create F_1 (½G ½V& ½ V½G sire breed is demonstrated first) for four parities. Weaning was performed at 28 days of kits age. Pre-weaning litter traits were measured (for instance, litter size at both birth (LSB), and at weaning (LSW); litter weight either at birth (LWB), and body weight at weaning (BWW)). Data were examined utilizing GLM and VARCOMP procedures of SAS took after by single and multi-trait animal model investigations (AM), which performed utilizing derivate free limited maximum likelihood (MTDFREML). The results revealed that *h^2* estimates for LSB and LSW were 0.133±0.01 and 0.15±0.063, respectively. The evaluations of coefficient of inconstancy (CV%) are 34.78% for LSB versus 39% for LSW, and 28.27% for LWB versus 33.53 % for BWW. The impact of mating groups on LSB and LSW, LWB and BWW had exceptionally significant being 7.921, 5.320, 0.402, and 0.450 kg for LSB, LSW, LWB and BWW for (G♂ X V♀), individually, while the proportional (V♂ X G♀) were 6.224, 4.80, 0.360, and 0.490 kg, separately. Parity significantly affected LSB, LWB, and BWW. Meanwhile, the impact of doe within buck as a random impact demonstrated an unacquainted impact altogether influenced all analyzed traits. Negative genetic correlation between litter size at birth and each of litter weight at birth and body weight at weaning. Additionally, environmental correlation between litter size at weaning and litter weight at birth was positive, while the environmental correlation between litter size at waning and body weight at weaning was negative but not significant. Furthermore, the precision of the evaluations of bucks breeding value (0.37 to 0.92) was higher than the exactness of doe (0.27 to 0.88) and progeny (0.36 to 0.85), which might be because of the higher number of descendants per buck. Subsequently, the outcomes demonstrated the significance of utilizing bucks of Gabali in rearing project to build the genetic advance.

Keywords: Litter traits - Pre-weaning - heritability- Genetic Correlation - Gabali-V-line

INTRODUCTION

The productive capacity of a rabbit doe depends extensively upon litter traits (i.e. litter size and weight) which constitute important economic composite traits in rabbit production. In this respect, Lukefahr *et al.* (1990) reported that litter weight at weaning is a composite trait of litter size, individual weight of rabbit per litter, doe milk production, post-natal mothering ability in addition to growth and survival of young from birth up to weaning. The low heritability coefficients (less than 0.20) for litter weight traits from birth up to weaning were reported by many authors working on Egyptian rabbits (i.e. Enab *et al.,* 2000). Likewise, litter size has low heritability, however they were by all accounts profoundly factor (Mantovani *et al.,* 2008), The most successive evaluations are around 0.08 for heritability and 0.15 for repeatability, and a reducing patter has also been seen from litter size at birth to litter size at weaning (Ragab and Baselga, 2011). Though, additive genetic variability is far from being considered negligible. Apart from genetic effects, litter traits are controlled by further environmental factors indicating that many environmental factors (e.g. Mating group, cross mating grouping, litter size, parity, intrauterine position of fetuses, nutritional supply) should include in the model of analysis mating group. Selection in maternal lines in rabbit is somewhat considering determination inside limited population which has amassed in mating grouping impacts (Ragab *et al.,* 2015), extending the hereditary variety amongst lines and, verifiably, changing the gene frequencies between population. Furthermore, two mating group crossing improved litter size and weight, pre-weaning livability, mean kit weight and rate of body weight increase when he worked on reciprocal cross between both New Zeland white and California with Chinchilla (Fayeye and Ayorinde 2000). In general, this is likely because of the per loci greater genetic differences or heterozygosity represented in the cross, the basis of hybrid vigor which has a positive effect on reproduction traits. Subsequently, cross mating gathering is a viable method for using accessible mating group resources and abusing hereditary variety between populations.

What's more, genetic merit relies upon the correlation between breeding value and phenotypic esteem. There are four sources of information used frequently to estimate the breeding values includes the animal itself, the animal's progeny, the animal's ancestors, and collateral relatives. These sources provide information on genetic merit because all the individuals are related to the animal either by descent or through common ancestors. the objective of rabbits breeding is to improve execution characteristics of rabbit population through both mating and selection. The determination model is generally considering best linear unbiased prediction (BLUP) of additive genetic effects; BLUP requires information about fluctuation parts that must be evaluated practically in practice. Because of it is desirable properties restricted maximum likelihood (REML) has turned into that technique for decision for the estimation of difference in variance components of mixed models. Conversely, the rabbit industry isn't as broadly spread as that for broiler or egg production ventures. The request of rabbit meat is for the most part subject to smallholders. They typically encounter high mortality rates and lowlevel execution and returns. So far, the potential economic benefits associated with cross mating grouping using optimal mating group combinations with respect to post-weaning litter traits of commercial significance have not been sufficiently explored. Accordingly, the targets of the present examination were to assess conceivable impact of non-hereditary factors on crossbreeding rabbit groups set up by proportional going between Gabali and V-Line (as a unique lines) on rabbits pre-weaning performance and estimate the genetic merit for their crosses. Where Sinai Gabali and Desert Gabali are considered as the two strains of Gabali rabbits, the two strains appear to be adjusted to the desert conditions (Khalil 1999). The aspirations of the present study are estimates phenotypic and genetic parameters for litter size at birth (LSB), litter size at weaning (LSW), litter weight at birth (LWB) and mean body weight at weaning (BWW). In addition, predicting breeding values for above traits studied in Sinai Gabali - as Egyptian rabbit breed-, V–Line and their crossing.

MATERIALS AND METHODS

Breeding plan

Two pure rabbit breeds were used in this study, the first one represents a native Egyptian breed (Sinai Gabali; G) and the other represents a standard exotic line (V-Line; V). Does and bucks of the exotic line (V-Line) are acclimatized descendants of the Spanish synthetic line. Crossbreeding system was applied in ten mating groups which contained 4-5 does per group. The first five groups consist of V-line does which were mated with 5 Sinai Gabali bucks (G♂ X V♀) and reciprocal crosses (V♂ X G♀) for the other five groups. Each buck was represented as a sire to all litters in each group to produce F_1 (½G ½V& ½ V½G; sire breed is indicated first). Weaning was performed at 28 days of kits age.

Rabbitry, housing and management

Animals were raised in a semi closed rabbitry, depending fundamentally on natural ventilation. Does were housed in singular pens gave settle boxes, feeders, and automatic drinkers. All rabbits were fed on a commercial lactating-pelleted-diet containing approximately 2600 Kcal/kg ration as digestible energy; 16.3% crude protein; 13.2% crude fiber and 2.5% fat. Feed and water were provided *ad libitum*. Does were mated from their same respective group assigned bucks 10 days post-kindling. Pregnancy was tracked/determined by palpation 10 days following mating. Females that neglected to conceive were come back to the same assigned buck to be re-reproduced. Inside twelve hours once encouraging, litters were checked and recorded. In this way, weaned a month kits were sexed and exchanged for additionally study to standard descendants prepared pens.

Statistical analysis

Source of Data

Data including pre-weaning litter traits (i.e. litter size at birth, LSB; litter size at weaning, LSW; litter weight at birth, LWB; and body weight at weaning, BWW). The distribution of data according to breed, sex, and parities are shown in Table 1.

Linear model

Data were preliminary analyzed using GLM and VARCOMP procedures of SAS (Statistical Analysis System, SAS 2001; version 8.1). The model of the analysis included the fixed effects of (sex, parity, and mating group) as well as the random effects of bucks and does within bucks and errors. The following linear models for traits studied are used to estimate the starting values of variance components needed for subsequent animal model analyses:

Y_{ijklm}=μ+ S_i + d_{ij} + S_k+ P_l + MG_m + e_{ijklmn}

Where:

Y_{ijklm} = the performance trait on the ijklmth rabbit; μ = the overall least squares mean; S_i = the random effect of the ith bucks; d_{ij} = the random effect of the jth doe nested within the ith buck; S_k = the fixed effect of the kth sex (Male = 1 and Female = 2); P_l = the fixed effect of the lth parity (l= 1, 2, 3, 4); MG_m= the fixed effect of the mth mating group (3 = G X V and 4 = V X G); e_{ijklmn} = the random error with mean zero and variance $\sigma^2 e$.

In addition, single and multi-traits animal model analyses (AM), were performed using derivate free restricted maximum likelihood (MTDFREML) as recommended by Boldman *et al.,* (1995). Traits studied were analyzed through single trait animal model (STAM). The model included the effects of sex, parity and mating group as fixed and the animal (progeny, Bucks and does); permanent; and the residual as random effects. Estimates of heritability (h^2), genetic correlations among different traits studied and estimation of breeding values and their accuracy are estimated according to Morde (1996) and program of MTDFREML (Boldman *et al.,* 1995).

RESULTS

Unadjusted means

Means of (LSB, LSW, LWB and BWW) are 7.504, 5.732, 0.403 kg, and 0.484 kg, respectively. Contrariwise, the estimates of CV% of doe litter traits increased from birth to weaning in general which indicate their lower phenotypic variation at kindling than that at weaning (Table 2).

Effect of mating groups

The present outcomes demonstrated that the genetic group of G♂ X V♀ had higher values for the above mentioned traits rather than V♂ X G♀ mating group, being 7.921, 5.320, 0.402, and 0.450 kg for LSB, LSW, LWB and BWW, respectively, while the corresponding for V X G were 6.224, 4.80, 0.360, and 0.490 kg, respectively (Table 3). The impact of Mating groups on litter size at birth and at weaning, litter weight at birth and body weight at weaning had exceedingly huge impacts (P≥0.001, Table 4).

Effect of parity and sex

Parity or lactation arrange significantly influenced litter size and weight at birth, litter size and body weight at weaning (P≥0.001, Table 4). Furthermore, the pattern of the impact of parity on most doe litter traits was inconsistent (fluctuated more with advance of parity order (Table 3). Differences between males and females had no significant effect on litter traits studied (P≥0.05, Table 4).

Random effects

Effect of bucks and doe within buck as random effects had highly significant effect on LSB, LSW and BWW. (P≥0.001, Table 4). The present results indicated the importance of selection bucks and does. Thus, selection of dam for the next generation would lead to higher genetic improvement in the Egyptian rabbits.

Heritability estimates

Litter size at birth (LSB), litter size at weaning (LSW) litter weight at birth (LWB) and body weight at weaning (BWW) which evaluated from Multi Trait Animal Model (MTAM) are presented in Table 5. Low heritability estimates for LSB and LSW for the three groups and ranged from 0.09 to 0.18. similar in trends for using all data the present results also, show that estimated of heritability for G♂ X V♀ Mating group are higher than those for V♂ X G♀ breed. Therefore, the results show the important of using bucks of Gabali to increase the genetic progress.

Correlations

Multi trait Animal Model (MTAM) analysis of variance and covariance were performed on the data of V- Line and Gabali breed to derive estimates of direct additive genetic (r_g) and environmental correlations (r_e) among different traits studied.

Genetic correlations

Genetic correlation between litter size traits are presented in (Table 6). Genetic correlations between litter size at birth and litter size at weaning was positive and not significant and being 0.02(0.239), while, the genetic correlation between litter size at weaning and body weight at weaning was positive and being 0.65 (0.631). Negative genetic correlation between litter size at birth and each of litter weight at birth and mean litter body weight at weaning (-0.29 and -0.33, respectively) and negative genetic correlation between litter size at weaning and litter weight at birth being (-0.96) and between litter weight at birth and body weight at weaning (-0.58), Table (6).

Environmental correlations

Environmental correlations between litter size at birth and each of litter size at weaning, litter weight at birth and body weight at weaning are certain and highly significant 0.50(0.07), 0.89(0.02) and 0.44(0.011), Table 6. Also, environmental correlations between LSW and LWB was positive and being 0.53(0.092), while the environmental correlation between LSW and BWW was negative and not significant (-0.01). Also, the environmental correlation between litter weight at birth and body weight at weaning was positive and being 0.73(0.089) (Table 6).

Predicted breeding value (PBV)

Estimates of minimum and maximum predicted breeding values (PBV) with standard errors (SE) and their accuracies (R) for litter size at birth (LSB), litter size at weaning (LSW), litter weight at birth (LWB) and body weight at weaning (BWW) from does predicted breeding values (D PBV’ S), bucks (S PBV’ S) and offspring predicted breeding values (P PBV' S) which are assessed by using Multi trait model are shown in (Table 7). The present results show large differences according to does, bucks and progeny for litter traits.

DISCUSSION

Unadjusted means

The present mean of LSB (7.504) are higher than those reported by many authors working on different rabbit’s breeds (Khalil, 1986; and Hassanian and Baiomy, 2011) which ranged between 5.4 to 6.5, While the present mean of LSB are lower than those reported by Costa *et al.,* (2004) which ranged from 7.7 to 10.6. Although the present mean of LSW (5.732) (Table 2) is higher than those reported by Afifi (2002) and ranged from 3.4 to 4.20, it’s lower than those reported by Costa *et al.,* (2004), and Youssef *et al.,* (2008). The present overall mean of litter weight at birth (LWB) is 0.403 kg (Table 2) which is higher than those found by EL-Kelany (2005) who worked on New Zealand White (0.384 kg), California (0.349 kg), Bauscat (0.366 kg), Flander (0.395 kg) and Baladi Black (0.335 kg). Furthermore, the body weight at weaning (BWW) was 0.484 kg at 4 weeks (Table 2) which was higher than those reported By Lukefahr *et al.,* (1990);

and García and Baselga (2002) and ranged from 0.269 gm to 0.464 gm, while the present mean of BWW was lower than those found by El-Kelany (2005); and Iraqi *et al.* (2006), and ranged from 0.503 gm to 0.680 gm.

The estimates of CV% are 34.78% for LSB vs. 39% for LSW, and 28.27% for LWB vs. 33.53 % for BWW. Similar results were obtained by Youssef (1992). The higher coefficient of variation observed for litter weight at weaning than at birth obtained by different investigators may be attributed this trend to the full dependency of the newly born or closed eyes bunnies (up to 12 days of ages) on their mother’s milk up to weaning. The variability of post-natal litter traits might be due to the variation in milk production traits which increases with advance of lactation stage. Then again, the pattern of milk characteristics could be influenced by the genotype contrasts among various does. additionally, because of that litters turn out to be less sensitive to the non-genetic maternal impact which diminishes with progress of litter`s age (Khalil 1986; and Afifi *et al.*, 1992). While, Blasco *et al.* (1992) explained the variation in litter traits at kindling on physiological basis, i.e., high variation in ovulation rate, uterine capacity of doe, and embryo and fetus persistence. Also, the relation between litter size and litter body weight seems to be curvilinear one; there are more substantial weight differences among kids in smaller litters than in larger ones.

Dam Breed

The present results show that the genetic group of G X V, when V-Line Rabbits acts as dams, were significantly (P≥0.001, Table 3) higher than their counterparts’ V X G for Litter size at birth, litter size at weaning, litter weight at birth and body weight at weaning. Similar results were reported by El-Kelany (2005). They concluded that the effect of breed may be relied upon to (1) the distinctions in ovulation rate and post– implantation reasonability, (2) the maternal impacts dictated by the quantity of develop or number ova shed at ovulation, fertilized and set up ova and the interior condition of a doe that she accommodates her litter and (3) contrasts in maternal impacts controlled by sustenance of the young during the suckling stage. Moreover, the differences in litter weights were intensely related to the litter size, because of positive and highly genetic correlation between litter size and weight at different ages. Since, a decrease in litter size is accompanied by an increase in average individual kit weight. In addition, El-Kelany (2005) worked with five rabbit’s breeds, found that the litter size at birth and litter weight at birth had lower for Black Baladi rabbits than those of NZW, Cal, Flander and Buascat rabbits. This underline it is essential to rely upon these standardized breeds to enhance regenerative characteristics. This might be because of contrast of climatic and administration condition notwithstanding genotype by environment interactions.

Parity and sex

Pairty had a significant effect on LSB, LBW, LWB and BWW (P≥0.01, Table 3). All traits increased as parity increased to the 2nd parity and therefore decreased. There was Simliar results are reported by Youssef (1992) and el- kelany (2005) working on Egyptian rabbits. Increasing in LWB with parity order was probably an indication for increasing doe maturity in terms of body size and uterine capacity, which enabled the doe to provide sufficient nourishment to fetuses during pregnancy. However, the variation in litter traits from kindling up to weaning for different parities might be controlled by the lactation and ability of doe to care and suckle her bunnies. The largest litter sizes at birth were reported in the second or third parity, while the first parity usually showed the smallest size (Nofal *et al.*, 1999). Also, the differences among parities were found to be significant in litter size at birth and at weaning (El-Kelany, 2005). Khalil *et al.* (1989) when he examined Basucat and Giza White rabbits, revealed that pre-weaning body weights and daily gain increased with advance of parity from first to the third parity and diminished from that point. This may be due to changes in the physiological efficacy of the dam, especially, those associated with nourishment and intrauterine environmental provided during pregnancy which occur with advance of parity. Differences between males and females for various body weights on other traits (P≥0.05, Table 4).

Heritability

The present estimate of h^2 for LSB are within the ranges (0.01 to 0.08) reported by different authors working on different breeds of rabbits using animal model (Cifre *et al.*, 1998; and Reda 2011). Estimate of heritability for LSW are comparable to those reported by García and Baselga (2002) (0.11). The low heritability estimates for litter size at birth and litter size at weaning, as wellness traits, showed that these characteristics are influenced principally by environmental factors. Change of feed and managerial conditions would help incredibly in enhancing LSB and LSW. In addition, Khalil (1986) concluded that the small estimate of heritability of litter size at birth in Bauscat might be due to the large maternal effects and variation within the litter sizes and dams and increasing non-additive genetic effects. Additionally, Iraqi *et al.*, (2006) worked with Gabali, New Zealand White and their crosses indicated that heritability estimates were low for LSB, LWB, LSW and LWW, respectively. They included that these small estimates of heritability for some litter traits (LSB, LWB, LSW and LWW) might be anticipated to the large maternal effect and /or variation because of permanent environmental effect, i.e. increasing non-additive genetic effects. Moreover, the low heritability estimates for LS demonstrated that the relative significance of additive genetic components is low and most change of these characteristics of imported group could be acknowledged by change of environment and management of litters after birth, because the period from birth to weaning is most sensitive to environmental and management changes. On other words, the present estimates of LSB and LSW are lower than those studies which used sire model (Nofal *et al.*, 1999; Enab *et al.*, 2000; and Nofal, 2002) and ranged from 0.15 to 0.54. This may be due to small amount of permanent environmental effects for litter size at birth in all breeds studied. Surprisingly, El–Kelany (2005) reported higher estimates of direct heritability for LSB and LSW, where, h^2 estimates for LSB rabbits were 0.631, 0.786, 0.597, 0.607 and 0.694, for New Zealand White, California, Bauscat, Flander and Black Baladi respectively. The direct genetic improvement for litter size traits is expected to be effective. Also, Enab *et al.* (2000) with New Zealand White and California, found that h^2 estimate for LSB were 0.468 and 0.562, respectively. Blasco *et al.* (1992) attributed the superiority of doe performance to good ovulation rate, better milk secretion, lower prenatal and post-weaning mortalities rate, good maternal behavior, and less sensitivity and more adaptability to the prevailing environmental conditions. However, the differences in LS population parameters might be in principal attributed to differences in breeding groups, feed in management, climatic conditions, diseases, and number of records (i.e. population size) available for the investigation. In this respect, the location and genetic changes in the same breed could be considered as the responsible factors for differences between estimates of the same breed. Heritability estimates for Litter weight at birth (LWB) and body weight at weaning (BWW) are 0.33 ± 0.061 and 0.23 ± 0.108, respectively (Table 5). The present estimate of h^2 for LWB was higher than those reported by Costa *et al.* (2004) (0.15); and Reda (2011) (0.170) working on different breeds of rabbits on different countries. Also, the present estimate of h^2 for body weight at weaning was higher than those found by Cifre *et al.* (1998) (0.13) working on V- Line. While the present mean of BWW was lower than those reported by Moura *et al.* (2001) ranged from 0.26 to 0.43. The moderate estimate of h^2 for LWB and BWW, suggests that more efforts could be made to bring about improvement LWB and BWW traits through individual selection as well as better management practices.

The moderate heritability estimates for body weight at weaning 0.23, 0.30 and 0.25 for all data, Gabali x V-line and V-line x Gabali Mating group (Table 5) respectively, indicated the important of selection of rabbits according to weaning weight. In this regard, Kassab (2004) with five breeds of rabbits found that the body weight at weaning were 0.36, 0.43, 0.31, 0.30 and 0.21 for Flander, California, New Zealand White, Bascut and Dark Baladi breeds, respectively, and reasoned that selection for weaning weight will give more prominent change in this trait than selection during childbirth. Additionally, these considerable assessments demonstrate the significance to design particular choice projects of sires.

Correlations

Genetic correlations

Genetic correlation between litter size at birth and litter size at weaning was certain but not significant, and the genetic correlation between litter size at weaning and body weight at weaning was also positive. In this respect, Afifi *et al.* (1992) found that the genetic correlations between litter size at weaning and litter weight at weaning were 1.08 and 0.77 in NZW and Cal respectively. In addition, Enab *et al.* (2000) detailed that the genetic correlation in NZW and Cal rabbits among litter traits were positive and in wide run from moderate to high and acknowledged in their investigation that the genetic correlation approximates amongst LSB and LSW were 0.78 and 0.98 in NZW and Cal rabbits respectively. While, between LSW and LWW were 0.83 and 0.98 respectively, in both NZW and Cal rabbits. The present outcome demonstrated that selection litter size at weaning will increase of BWW. Additionally, the inconsistency in the genetic correlation amongst Gabali and V-line and different breeds in rabbits might be ascribed to mating group contrasts in milking and mothering capacity and in litter misfortunes which may have happened amid the suckling time, comparative outcomes were found by Khalil *et al.* (1987). Likewise, negative genetic correlation between litter size at birth and each of litter weight at birth and mean litter body weight at weaning, what's more, negative genetic correlation between litter size at weaning and litter weight at birth, and between litter weight at birth and body weight at weaning. The present outcomes showed that determination for expanded litter size at birth would bring about a correlated decline in body weight at weaning. Khalil (1986) demonstrated comparative outcomes by general pattern for litter size at birth to be negatively genetically correlated with individual mean weight at weaning with Bauscat and Giza White rabbits. Similarly , expected direct choice gave more prominent change in litter weight at weaning and body weight at weaning than indirect selection. Likewise, Enab (2001) found that the genetic correlation between litter size at birth and mean litter weight at weaning were negative and being - 0.69 and - 0.66, respectively.

Environmental correlation

Environmental correlation between litter size at birth and each of litter size at weaning, litter weight at birth and body weight at weaning were positive. Additionally, environmental correlation between litter size at weaning and litter weight at birth was positive, while the environmental correlation between litter size at weaning and body weight at weaning was negative and not significant. Also, the environmental correlation between litter weight at birth and body weight at weaning was positive. Similar results were reported by Khalil (1986) worked with Basucta and Giza White rabbits, found that environmental correlations between LSB and each of LWB, LSW and LWW were mostly positive and ranged from intermediate to very high for both breeds. In addition, Afifi *et al.* (1992) announced that environmental correlations between litter size and litter weight characteristics were positive and for the most part high in both NZW and Cal rabbits. Likewise, found that the environmental correlations amongst LWB and LWW was 0.47 in NZW rabbits. These discoveries in their investigation may underscore the nearness of extensive environmental doe consequences for her litter traits.

Predicted breeding value (PBV)

Result in Table (7) demonstrates the significance of doe and progeny, since they gave the higher scope of breeding value for litter size at either birth or at weaning. In this way, selection of doe and progeny for the cutting edge would prompt higher hereditary change in the breed Gabali, V – Line and their crosses. Moreover, Table (7) demonstrates that the precision of the assessments of bucks breeding value (0.36 to 0.92) was higher than the exactness of doe (0.27 to 0.88) and offspring (0.37 to 0.85), which might be because of the higher number of progenies per buck. Nofal *et al.* (1999) estimated sire transmitting limit with respect to litter size at birth (LSB) litter size at weaning (LSW) and litter weight at weaning (LWW), found that the extent of transmitting limit was - 0.25 to 0.22, - 0.36 to 0.24 and 172.31 to 128.93 gm, for LSB, LSW and LWW, respectively. Likewise, Farid *et al.* (2000) found that extents in doe breeding values (DBV) for litter size of all Bouscat does diminished with progress of age of the litter. Interestingly, in California rabbits, these extents expanded with progress of age of the litter from birth up to weaning., while, in NZW rabbits, these achieves reduced from birth up to 21 days and extended from that point on up to weaning. This may be a direct result of that the declaration of the genotype is clearer at weaning than at earlier ages. Accordingly, selection for a composite trait at weaning (e.g. LWW) may be more compelling to enhance numerous traits than determination for a trait either at birth or at weaning. Comparable outcomes are additionally, detailed by Moura *et al.* (2001) with Bouscat rabbits, utilizing Multi-trait animal model, found that the normal breeding value for number weaned/litter conceived, litter weaning weight were 0.04±0.010 young/litter, 0.039±0.006 youthful/litter and 35.2±4.6 gm, separately. Likewise, they uncovered that conceptive and litter characteristics showed slight, however incredible hereditary changes. It has every one of the reserves of being conceivable to complete direct, however synchronous contrast in litter and growth traits with a various characteristic confirmation program in rabbits. In conclusion, the present outcomes demonstrated the significance of dam selection that would prompt sensible genetic change in the tried rabbits. In like manner, the significance of utilizing bucks of Sainai Gabali in reproducing project to expand the genetic progress. Furthermore, the broiler breeds of rabbits for commercial production ought to however be based on weaning kit performance.

Table (1): Distribution of data according to breed, sex, and parity.

Observation	**No. of records**
Breed	
Gabali X V-line	203
V-line X Gabali	245
Sex	
Male	218
Female	230
Parity	
1^{st}	157
2^{nd}	185
3^{rd}	90
4^{th}	16
No. of record	509
No. of Progeny	448
No. of Bucks	16
No. of does	45
Animal in the relationship matrix A^{-1}	430

Table (2): Actual means, standard deviations (SD) and coefficients of variation (CV %) for doe litter traits.

Traits	No. of litters	Means	SD	CV%
Litter size at birth (LSB)	448	7.504	2.610	34.78
Litter size at weaning (LSW)	448	5.732	2.236	39.00
Litter weight at birth (LWB)	448	0.403	0.113	28.27
Body weight at weaning (BWW)	448	0.484	0.162	33.53

Table (3): Least-Squares means and standard errors (LSM±SE) of Litter size and weight traits as affected by sex, parity and breed group.

Factors	No.	LSB Mean±SE	LSW Mean±SE	LWB Mean±SE	BWW Mean±SE
Breed group					
G♂ X V♀	203	7.921±0.202	5.320±0.180	0.402±0.008	0.450±0.012
V♂ X G♀	245	6.224±0.220	4.800±0.192	0.360±0.009	0.490±0.013
Parity					
1st	157	6.794±0.191	5.464±0.171	0.360±0.008	0.570±0.011
2nd	185	8.150±0.180	6.142±0.160	0.433±0.007	0.455±0.011
3rd	90	7.304±0.253	5.762±0.230	0.424±0.011	0.421±0.015
4th	16	6.041±0.600	2.860±0.540	0.310±0.026	0.420±0.037
Sex					
Male	218	7.260±0.213	5.180±0.190	0.390±0.01	0.473±0.013
Female	230	6.900±0.205	4.933±0.183	0.374±0.01	0.460±0.012

Where, LSB = Litter size at birth; LSW = Litter size at weaning; LWB= Litter weight at birth; BWW = Body weight at weaning. Least-squares means ±SE. in the same column within each effect bearing different capital or small letters differ significantly (P≥0.01 or 0.05, respectively).

Table (4):F-Ratio of Least squares analysis of variance of different factors affecting Litter size and weight.

Source of variation	F-Ratio				
	Df	LSB	LSW	LWB	BWW
Between bucks	15	13.15***	3.79***	6.97***	4.97***
Between does : bucks	44	16.47***	9.05***	8.79***	7.69***
Between Sex	1	1.79 ns	0.61 ns	0.58 ns	0.00 null
Between parity	3	21.72***	10.31***	25.99***	24.81***
Residual	384	19.34	9.72	11.03	9.06

Where, LSB = Litter size at birth; LSW = Litter size at weaning; LWB= Litter weight at birth; BWW = Body weight at weaning. * =P≥0.05, **=P≥0.01 or ***=P≥0.001.

Table (5): Estimates of heritability (h^2) and their standard errors (± SE) for litter traits (litter Size and litter weight) for all data, for G♂ X V♀, and V♂ X G♀ breed as estimated by animal model.

Traits	Heritability (h^2 ± SE)		
	All data	Gabali x V-line	V-line x Gabali
Litter size at Birth (LSB)	0.133 ± 0.01	0.18 ± 0.026	0.15 ± 0.133
Litter size at weaning (LSW)	0.15 ± 0.063	0.16 ± 0.023	0.09 ± 0.063
Litter weight at Birth (LWB)	0.33 ± 0.061	0.42 ± 0.185	0.12 ± 0.061
Body weight at weaning (BWW)	0.23 ± 0.108	0.30± 0.108	0.25 ± 0.108

Sire breed is preceding Dam breed

Table (6): Estimates of genetic (above diagonal) and Environmental (below diagonal) correlations between Litter traits (Litter Size and Litter weight) in rabbits as estimated by MTAM.

Correlated traits	**LSB**	**LSW**	**LWB**	**BWW**
Litter size at Birth (LSB)		0.02 (0.239)	-0.29 (0.373)	-0.33 (0.788)
Litter size at weaning (LSW)	0.50 (0.072)		-0.96 (0.154)	0.65 (0.613)
Litter weight at Birth (LWB)	0.89 (0.025)	0.53 (0.092)		-0.58 (0.091)
Body weight at weaning (BWW)	0.44 (0.111)	-0.01 (0.100)	0.73 (0.089)	

Table (7): Minimum and maximum of predicted breeding values for does (D PBV’ S), sires (S PBV’ S) and all progeny (P PBV’ S), their Standard Errors predicted (SE) and accuracy of predicted (R) estimated by MTAM for Litter traits (litter size and weight) for Gabali, V-line rabbits and their crosses.

Traits	(D PBV’ S)						(S PBV’ S)						(P PBV’ S)					
	Minimum			Maximum			Minimum			Maximum			Minimum			Maximum		
	PBV	SE	R	PBV	SE	R	PBV	SE	R	PBV	SE	R	PBV	SE	R	PBV	SE	R
LSB	-0.102	0.03	0.35	0.121	0.04	0.87	-0.125	0.02	0.36	0.086	0.04	0.90	-0.148	0.03	0.68	0.250	0.04	0.84
LSW	-1.838	0.43	0.27	1.368	0.54	0.73	-1.065	0.36	0 386	0.802	0.55	0.77	-1.271	0.45	0.37	0.977	0.52	0.67
LWB	-185	50	0.37	215	100	0.88	-158	40	0.37	135	100	0.92	-246	60	0.70	684	80	0.85
BWW	-205	50	0.36	360	100	0.88	-140	40	0.36	92	100	0.92	-203	60	0.69	329	80	0.85

Where, S PBV: Sire predicted breeding value, D PBV: Dam predicted breeding value, P PBV: Progeny predicted breeding value, LSB: litter size at birth, LSW: litter size at weaning, LWB: litter weight at birth, BWW: body weight at weaning.

REFERENCES

Afifi E.A., Yamani K.A., Marai F.M., El-Maghawry A.M. 1992. Environmental and genetic aspects of litter traits in New Zealand White and Californian rabbits under theEgyptian conditions. *J. Appl. Anim. Res.* 15, 335- 351

Afifi, E.A. 2002. The Gabali rabbits. Rabbit genetic resources in Mediterranean countries, 51-64.

Blasco A., Santacreu M.A., Thompson R., Haley C.S. 1992. Estimates of genetic parameters for ovulation rate, prenatal survival and litter size in rabbits from an elliptical selection. *Lives. Prod. Sci.* 34, 163-174

Boldman K.C., Kriese L., Van Vleck L.D., Van Tassell C.P., Kachman S.D. 1995. Manual for use of MTDFREML, A set of programs to obtain estimates of variances and co-variances DRAFT.USA. Department of Agriculture Research Service.

Brun J.M., Rouvier R. 1988. Evaluation of the genetic parameters of litter traits in crosses of two selected strains of rabbits. A synthesis. 4th world Rabbits Congress, Budapest, Hungary. 158-175.

Cifre P., Baselga M., Gacia-Ximenez F., Vicente J. 1998. Performance of hyper prolific rabbit line. I. Litter size traits. *J. Anim. Breed. Genet.* 115, 131-138.

Costa C., Baselga M., Lobera J., Cervera C., Pascual J.J. 2004. Evaluating response to selection and nutritional needs in a three-way cross of rabbits. *J. Anim. Breed. Genet.* 121, 186–196.

EI-Raffa A.M. 1994. Some factors affecting economical productive and reproductive traits in rabbits. Ph.D. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

EI-Raffa A.M. 2000. Animal model evaluation of V Line Rabbits raised under Egyptian conditions. *Egyptian Poult. Sci.* 20, 1003-1016.

El-Kelany M. 2005. Selection indexes for some economic traits on rabbits. M. Sc. Thesis, Faculty of Agriculture, Tanta University, Egypt.

El-Maghawry A.M., Ahmed S.S., Yamani K.A., Radwan H. 1999. Some reproductive and productive traits of New Zealand White, Rex rabbits and their crosses. *Egyptian J. Rabbit Sci.* 9, 159-177.

Enab A.A. 2001. Genetic evaluation of multi-trait selection indices for overall economic improvement in rabbit breeding programs. *Egyptian Poult. Sci.* 21 (1): 221-236.

Enab A.A., El-Weshahy OA and Abdou FH 2000. Genetic analysis of some economic traits in rabbits. *Egyptian J. Rabbit Sci.* 102, 327-339.

Falconer D.S., McKay T.F.C. 1996. Introduction to quantitative genetics. 4th ed. Longman. Essex, England.

Farid A., Afifi E.A., Khalil M.H., Gad H.A. 2000. Estimation of doe breeding values for litter traits of three standard breeds of rabbits raised under commercial intensive system of production in *Egyptian J. Rabbit Sci.* 10, 307-325.

Fayeye T.R., Ayorinde K.L. 2000. Heterosis and reciprocal effect for litter characteristics in rabbit crosses. Proceedings of the 25th Annual Conference of the Nigerian Society for Animal Production, (NSAP), Michael Okpara University of Agriculture, Umudike, Abia State 25, 248-251.

García M.L., Baselga M. 2002. Genetic response to selection for reproductive performance in a maternal line of rabbits. *World Rabbit Sci.* 10, 71–76.

Garcia M.L., Baselga M., Larva R., Larva F., Vicente J.S. 2000. Reproductive characters in crossbreeding among three maternal lines of rabbits. 7th World Rabbit Congress, Valencia, Spain. A, 397-401

Hanna M.F.S. 1992. Studies on some productive traits in rabbits M.Sc. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Banha Branch, Egypt.

Hassanien H.H.A., Baiomy A.A. 2011. Effect of breed and parity on growth performance, litter size, litter weight, conception rate and semen characteristics of medium size rabbits in hot climates. *Egyptian Poult. Sci.* 31, 97-110.

Iraqi M.M., Ibrahim M.K., Hassan N.S.H., El-Deghadi A.S. 2006. Evaluation of litter traits in purebred and crossbred rabbits raised under Egyptian conditions. Livestock Research for Rural Development, 18, #83.

Kassab R. 2004. A study of some economic traits on rabbits. M.Sc. Thesis, Faculty of Agriculture, Tanta University, Egypt.

Khalil M.H. 1986. Estimation of genetic and phenotypic parameters for some productive traits in rabbits Ph. D. Thesis, Fac. Agric. Sci., Moshtohor, Zagazig University, Banha Branch, Egypt.

Khalil M.H. 1999. Rabbit genetic resources of Egypt. *Anim. Genet. Res. Info.* 26:95-111.

Khalil M.H., Afifi E.A., Kadry A.E.A. 1989. Genetic analysis of weight of doe rabbits during gestation and its phenotypic relationship with reproductive efficiency at kindling. *J. Appl. Anim. Res.* 12, 45-51.

Khalil M.H., Afifi E.A., Owen J.B. 1987. A genetic analysis of body weight in young Bauscat and Giza White rabbits. *Anim. Sci.* 45,135-144.

Lukefahr S., Cheeke P.R., Patton N.M. 1990. Prediction and causation of litter market traits from pre-weaning and weaning characteristics in commercial meat rabbits. *J. Anim. Sci.* 68, 2222-2234.

Lukefahr S.D., Hohenbaken W.D., Cheeke P.R., Patton N.M. 1984. Genetic effects on maternal performance and litter pre-weaning and post-weaning traits in rabbits. *Anim. Scie.* 38, 293-300.

Mantovani R., Sartori A., Mezzadri M., Lenarduzzi M. 2008. Genetics of maternal traits in a new synthetic rabbit line under selection. In: Proc. 9th World Rabbit Congress, Verona, Italy, 169-174.

Morde R.A. 1996. Linear models for the prediction of animal breeding values. CAB International, Hulling Ford Oxon ox 108 DEUK.

Moura A.S.A.M.T, Costa A.R.C, Polastre R. 2001. Variance components and response to selection for reproductive litter and growth traits through a multi-purpose index. *World Rabbit Sci.* 9, 77-86.

Nofal R.Y. 2002. Best linear unbiased prediction BLUP of doe reproductive and litter mortality traits of New Zealand White rabbits. Allattenyesztes es Takarmanyozas, 516, 625-633.

Nofal R.Y., Abd El-Ghany A.M., Amin A.A.A., Ahmed E.G., Virag G.Y. 1999. Mixed model genetic analysis of litter size and weight traits in New Zealand White rabbits reared under Hungarian conditions. The 1st Inter.

Conf. on indigenous versus acclimatized rabbits Fac. Envi. Agric., Sci., Suez Canal Univ. El-Arish, North Sinai, 1199, 101-108.

Ragab M., Baselga M. 2011. A comparison of reproductive traits of four maternal lines of rabbits selected for litter size at weaning and founded on different criteria. *Lives. Sci.* 136, 201–206.

Ragab M., Sánchez J.P., Baselga M. 2015. Effective population size and in breeding depression on litter size in rabbits. A case study. *J. Anim. Breed. Genet.* 132, 68–73.

Reda F.M. 2011. Molecular genetics and its relation with inheritance of some productive and reproductive traits in rabbits. Ph.D. Thesis, Faculty of Agriculture, Zagazig University, Egypt.

Statistical Analysis System (SAS) 2001. User's Guide: Statistics, Version 8.2. SAS Institute, NC, USA.

Saleh K., Nofal R., Younis H., Abou Khadiga G. 2005. Evaluation of line V, Baladi black rabbits and their crosses under Egyptian conditions. 2- Litter weight and mean kit weight. 4th International conference on rabbit Production In hot climate. sharm El-sheikh, Egypt 31-37

Youssef Y.M.K. 1992. The productive performance of purebred and crossbred rabbits. M. Sc. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Bahna Branch, Egypt.

Youssef M.K., Iraqi M.M., El-Raffa A.M., Afifi E.A., Khalil M.H., García M.L., Baselga M. 2008. A joint project to synthesize new lines of rabbits. In Egypt and Saudi Arabia: emphasis for results and prospects. In: Proc. 9thWorld Rabbit Congress, Verona, Italy, 1637-1642.

الملخص العربى

تأثير الخلط بين الأرانب الجبلي والـ V-line على صفات ما قبل الفطام بإستخدام طرق الجدارة الثلاثية والجينية.

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أجريت هذه الدراسة داخل مهمة تهدف إلى تفصيل الخيارات والاستراتيجيات لتطور خط الأرانب باستخدام سلالتين نقيتين ((V-line (V و Gabali (G)). تم استخدام سجلات 448 نتاج تم انتاجهم بواسطة 45 أم ، وتم استخدام 16 أب لتقدير التباين ، المكافئ الوراثي (h^2) ، والارتباط الوراثي والمظهري ، والقيم التربوية في الصفات الإنتاجية تم تقييمها في التركيب من التهجينات المرتبة لعشر مجموعات تزاوج. تتكون المجموعات الخمس الأولية من (G♂ X V♀) والتزاوج المتبادل (V♂ X G♀) للمجموعات الخمس الأخرى. تم تمثيل كل ذكر على أنه أب لجميع النتاج في كل مجموعة لإنشاء F1 (V½G & ½ G ½V ½ يظهر سلالة الأب أولاً) لأربعة بطون. تم إجراء الفطام في 28 يومًا من عمر الخلفات. تم قياس صفات ما قبل الفطام (على سبيل المثال ، حجم الخلفات في كل من الولادة (LSB) ، والفطام (LSW) ؛ وزن الخلفات إما عند الولادة (LWB) و وزن الخلفات عند الفطام (BWW)).

تم تحليل البيانات باستخدام طرق GLM و VARCOMP لـ SAS بعد إجراء و تحقيق نموذج حيواني واحد ومتعدد السمات (AM) ، والتي أجريت للإستفادة من إمكانية استخدام نموذج الحيوان متعدد الصفات (MTDFREML). أظهرت النتائج أن تقديرات h^2 لـ LSB و LSW كانت 0.133± 0.01 و 0.15 ± 0.063 على التوالي. تقييم معامل الإختلاف (CV%) هي 34.78٪ لـ LSB مقابل 39٪ لـ LSW ، و 28.27٪ لـ LWB مقابل 33.53٪ لـ BWW. كان تأثير مجموعات التزاوج على LSB و LSW و LWB و BWW معنويا حيث بلغ 7.921 و 5.320 و 0.402 و 0.450 كجم لـ LSB و LSW و LWB و BWW لـ (G♂ XV♀) ، بشكل فردي ، بينما كان بالنسبة لـ (♂V XG♀) 6.224 و 4.80 و 0.360 و 0.490 كجم ، بشكل منفصل. أثر ترتيب البطن بشكل كبيرعلى كلا من LSB و LWB و BWW. وفي الوقت نفسه ، فإن تأثير الأم داخل الآباء كتأثيرات عشوائية أظهرت تأثيرات مختلفة الاتجاهات تماما على جميع الصفات التي تم تحليلها. علاوة على ذلك، وجد إرتباط وراثي سلبي بين حجم البطن عند الولادة وكل من وزن البطن عند الولادة ووزن الجسم عند الفطام ،بالإضافة إلى ذلك ، كان الإرتباط البيئي موجب بين حجم البطن عند الفطام ووزن البطن عند الولادة ، في حين أن الإرتباط البيئي بين حجم البطن عند الفطام ووزن الأرانب عند الفطام سلبي ولكن ليس معنويا. كانت دقة تقييم القيمة التربوية للآباء (0.37 إلى 0.92) أعلى من دقة الأمهات (0.27 إلى 0.88) ونتاجهم (0.36 إلى 0.85) ، والتي قد تكون بسبب إرتفاع عدد الخلفات لكل أب. أظهرت النتائج أهمية استخدام الآباء الجبلي في أي مشروع تربية لبناء خطوط مميزة وراثيا.