Egyptian Journal of Rabbit Science, 32 (2): 163 -180(2022)

GENETIC PARAMETERS AND EPIGENETIC TREND OF LITTER SIZE TRAITS OF ACCLIMATIZED NEW-ZEALAND WHITE RABBITS IN EGYPT

Hassan, N. S. [1]; A. M. Abdel-Ghany[2]; Safaa. S. Sanad[1]; H. A. H. Abd El-Halim[1] and M. G. Gharib[2]*

[1]*Animal Production Research Institute (APRI), Agriculture Research Center (ARC), Egypt.*

[2]*Department of Animal Production, Fac. of Agric., Suez Canal Univ. 41522. Ismailia, E*gypt.

***Corresponding author:** *e.mail:* mghreeb95@ yahoo.com

ABSTRACT: *A total of 93 litters produced from 36 does pedigreed by 13 dams and 9 sires, were analyzed using Animal Model Procedure (MTDFREML). Traits assessed were Litter Size traits, at birth, LSB; at 21 days, LS21 and at weaning, LSW (at 35 days) on two consecutive years. Heritability estimates of all considered litter traits were low. Genetic correlations among LSB and LSW were moderate and positive (0.490). The ranges of the NZW does transmitting ability (TA) were 0.814, 0.278 and 0.168 bunny for LSB; LS21 and LSW traits, resp. The percentages of positive breeding values estimate were 48.7, 48.7 and 56.4% for LSB; LS21 and LSW traits, rasp. Comparable significant moderate Pearson and Spearman correlation were obtained among BLUP's values& Ranks of the studied traits and they could both especially in cases with complexity of computations. Epigenetic Trend (EPG) with parities, the highest for Litter Size traits response was to the first parity. LS showed that epigenetic trend with Year-season (Y-S) effects gave better positive trends during good environmental circumstances and genetic expression could possibly change one environmental circumstance to another.*

Conclusively*, this study recommends providing the acclimated New Zealand rabbits in Egypt more consideration and genetic improvement through selection to reach the performance of the standard breed due to the significant amounts of the trait's non-additional genetic component.*

Keywords: Rabbits, litter size traits, heritability, BLUP's, and Epigenetic trend.

INTRODUCTION

Rabbits are gaining popularity as an alternative source of animal protein to meet the growing need from the continuously growing human population. Recently, the practice of raising rabbits has become more popular in underdeveloped nations like Egypt. Hereditary improvement of Egyptian rabbits of economically/monetarily significant trait qualities, especially doe litter ones, is a significant component of anticipated strategic procedure to further enhance benefit and supportability of broiler bunnies' plans. Portrayal factors that influence short- and long-term hereditary progress, selection, and mating methodologies in a population are vital to build and afterward assess hereditary improvement programs and decide regions that should be altered and gotten progressed to the next level (Hassan *et al.*, 2015a).

Genetic correlation between traits, though of its importance, necessitates special data structures and sometimes it is hard to get or even impossible. As the number of traits increases in the analysis, especially animal model, it changes and become more and more unfeasible and impractical. Finding a statistical way to compare between the actual genetic correlations and those between BLUP's values& Ranks could offer a solution for such problem (Hebert *et al.*, 1994).

The Egyptian native and/or Acclimatized exotic rabbit breeds, should be a piece of our native hereditary assets that should go through more investigation and exploration, first to conserve them and second to uncover their distinctive distinguishing characteristics and to elevate them to opposing the enthralling exotic ones. Consequently, the precise assurance of hares' hereditary boundaries and reproducing values for most monetary attributes, of such populaces, are fundamental for scheming and to accomplish progress in their breeding plans, propagation programs and rearing projects.

Thus, the aims of this study are, to estimate the variance components; genetic parameters and extrapolate the epigenetic trends of the BLUPs' values as well as their correlations for the pre-weaning litter size (LS) traits in NZW rabbits and provide and characterize a best understanding of the factors influencing the genetic change of a rabbit's population's economic trait yield.

MATERIALS AND METHODS

Animals and experimental design:

The data of the present study was carried out at Sakha Station Rabbits Farm, (APRI), (ARC), Ministry of Agriculture, Egypt; on 93 litters of acclimatized New Zealand White (NZW) rabbits produced from 36 does pedigreed by 13 dams and 9 sires. Assessed records were Litter Size traits for two consecutive years rabbits (2008–2009), at birth, 21 days, at weaning age at 35 days (LSB, LS21 and LSW; resp.). All rabbit does were fed a consistent commercial pelleted ration that contained approximately 18% crude protein, 2.39 percent fat, 12.8 percent fiber with digestible energy of 2550 kcal/kg diet. Also, feed and water were provided all day long.

Breeding plan began in October 2008 and ended in late spring 2009. For breeding, each doe was assigned a specific buck to be bred with, and she was palpated 10 days later to check for pregnancy. Does that were unable to conceive were returned to their assigned buck to be rebred.

Statistical and genetic analysis:

The starting values of the (Co) variance matrix, for every studied trait, were obtained using the SAS, 2003 REML method of the VARCOMP procedure. The data was analyzed using a Multi-Trait Animal Model Procedure (MTDFREML) of Boldman (1995) that included the effects of parity and year-season combinations (as fixed factors), as well as additive genetic and permanent environmental effects (as random effects, encompassing the combination between the doe and the parity in which the litter was born). The following animal model (in matrix notation) was used:

$$\mathbf{y} = \boldsymbol{Xb} + \boldsymbol{Z_a}\, \boldsymbol{u_a} + \boldsymbol{Z}_{\mathbf{pe}}\, \boldsymbol{u}_{\mathbf{pe}} + \boldsymbol{e}$$

Where: y= Vector of observations on animal for litter size traits; b= Vector of unknown fixed effect peculiar to parity (4 levels) and year-season (4 levels); u_a= Vector of random additive genetic effects of the animal for the i^{th} trait; u_{pe}= Vector of random permanent environmental effects (pe; doe–parity combination), e= Vector of random error; esp., Z_a and Z_{pe} are incidence matrices relating records of i^{th} trait to the fixed, random animal and random permanent environmental effects; resp.

Direct heritability (h^2_a) was estimated as following:

$$\mathbf{h^2_a = (\sigma^2_a / \sigma^2 p)}$$

Where: σ^2_a = Additive genetic variance and $\sigma^2 p$ =Phenotypic variance.

Animals predicted transmitting abilities (TA_i):

The animals' transmission abilities (BLUPs & TA), peculiar accuracies (r_{AA}), and standard errors, SE_{Ai}, were assessed using the same package. Hence; the same software (MTDFREML) of Boldman (1995).

Correlation effect study between BLUP values and ranks:

Alternative type of genetic correlation, which differs from the correlation resulting from the analysis of multi-trait animal models, is that the former expresses the realized association between the breeding values of the animals. The Product moment (Pearson for BLUPs) is computed using the transmitting abilities (TA or BLUPs') estimated using MTDFREML, as well as their predicted ranks (Spearman for BLUP ranks). For the entire set of animals (sires, dams, and does) and for does, correlation coefficients between the analyzed litter features were calculated by SAS (2003).

Epigenetic trend (EPG):

Even for Egypt acclimatized exotic rabbit breeds, genetic enhancement of profitable reproductive traits, especially litter traits, are crucial, or else they would deteriorate due to the relieve of the adopted selection pressure. Factors affecting genetic improvement may vary under different environmental conditions. Differences in these environmental factors (For example, parity, month or season of kindling, *etc*.) were discovered to be extremely significant for the Litter-size performance of rabbits (Hassan *et al.,* 2013 and 2015a). The cumulative effect of genes, together with environmental effects, results in ongoing phenotypic variation, value of exposed individuals. Differences among different types of environmental conditions may affect the extent and quantity of the resultant genetic manifestation of the traits under consideration. Epigenetic trends (as a kind of genetic by environment interaction) were calculated using the method found that Legates and Myers (1988) as the deviation of the mean of the (TA's) of the group of animals that were successful in recovering production under the environmental situations they were exposed to, from the overall mean of the entire group of animals across all environmental situations' BV using SAS (2003).

The results were then plotted on graphs. To exemplify the general tendency pattern of a specific trait under variable classes of the fixed effect under interest (*i.e.*Year-season, Y-S and parity, P).

RESULTS AND DISCUSSION

Actual means, standard deviations (SD), and coefficients of variation (CV %) are the actual values. For doe litter size traits (LSB, LS21day and LSW) to characterize the Egypt-Acclimatized New Zealand White rabbits are given in Table 1.

Means of the doe litter size traits are within the ranges observed by many researchers (*e.g.* Amira El-Deghadi, 2019; Rabie, *et al.*, 2019*;* Mahmoud and Walid, 2020 and Montes-Vergara *et al.*, 2021) on NZW rabbits. Whereas, it were higher than those attained by Abdel-Kafy *et al.*, (2012); Fayeye and Ayorinde (2016)*;* Zaharaddeen and Kabir (2018) and Fatma Behiry *et al.*, (2021) on different breeds of rabbits. The former reflects superiority in their prenatal and postnatal maternal abilities and furthermore high milk production capabilities in NZW rabbits (Amira El-Deghadi, 2019).

Table 1: Actual means, standard deviations (SD) and coefficients of variability (CV %) of litter Size traits for the acclimatized NZW rabbits.

Trait	**Overall Mean**	**SD**	**CV%**
Litter Size traits (LS)			
At birth , LSB	6.13	2.00	32.65
At 21 day, LS21	5.86	2.02	34.42
At weaning, LSW	5.49	1.96	35.68

Coefficients of variability (CV %) for Litter size traits were relatively moderate and ranged from 32.65 to 35.68 % (Table 1). Estimates of CV% for litter size traits increased, in general, as rabbit bunnies advance in age (indicating lower phenotypic variation at birth than that at weaning). Similar results were reported by many authors (*e.g.* Amira El-Deghadi, 2019 and Mahmoud and Walid, 2020) on NZW rabbits; as well by Abdel-Kafy *et al.*, 2012; and Fatma Behiry *et al.*, (2021) on different breeds of rabbits. These results of CV% getting larger with advance of bunnies age may be because litters evolved between kindling and weaning became more sensitive to the non-genetic effects (*e.g.* parity, age of doe, litter size at birth …*etc*.), Amira El-Deghadi (2019).

Variance component estimates (σ^2):

Estimates of additive genetic variance (σ^2_A) for litter size traits were somewhat low and ranged from 0.016 to 0.149. These results denote no-clear trend in σ^2_A, (proportions –between two parentheses was only estimated for σ^2_A only, Table 2). The additive variation of reproductive qualities has been reduced through long-term natural selection on the one hand, and artificial selection of such traits for NZW rabbits in their nation of origin on the other. Although LS21 and LSW apparently (not tested) to be somewhat age-related (*i.e.* their proportions seems to be less in elder ages). However, litter size traits as transitional and fitness traits for animals and especially for NZW are expected to be marginal with expendable genetic variation as they are constantly subject to natural& artificial selection. Similar results were observed by Abdel-Kafy *et al.*, (2012) and Amira El-Deghadi (2019) who found the same trend of the additive variance components for litter sizes with a different breed of rabbits (*i.e.* Baladi-Black). These findings seemed logical, reflecting the enormous environmental component of variance associated with the error term of the rabbit does during the suckling period and during raising of their litters to weaning (Hassan *et al.*, 2015a& b, Table 2). Permanent environmental effect (σ^2_{pe}) of litter size traits were comparatively very small in magnitude/ negligible. In this respect Abdel-Kafy *et al.*, (2012); Hassan *et al.*, (2015) and Amira El-Deghadi (2019) introduced similar trends of common litter effects.

Heritability estimate (h^2_a)

Heritability estimated for litter size traits were relatively low and ranged from 0.01 to 0.04 (Table 3). Similar results were also reported by Abdel-Kafy *et al.*, (2012); Hassan *et al.*, 2013 and Hassan *et al.*, 2015a& b on different breeds of rabbits. These estimates were within the ranges of Amira El-Deghadi (2019) and Mahmoud and Walid (2020) working on NZW. However, Mahmoud and Walid (2020) proclaimed that h^2_a for LSB and LSW of NZW rabbits, were 0.05 and 0.07 respectively. Amira El-Deghadi (2019) declared that, estimates of h^2_a for litter size traits, again with NZW rabbits, were low and ranged from 0.01 to 0.06. On the other hand, Fatma Behiry *et al.*, (2021) on APRI rabbits stated that, h^2_a for LSB and LSW were 0.10 and 0.14 respectively.

Low h^2_a estimates could be attributed to that these are fitness& transitional traits and were subjected to natural selection resulting in

Table 2: Additive genetic (σ^2_A), phenotypic (σ^2_P) and Permanent environmental effects (σ^2_{pe}) co-variance of Litter Size traits for the Acclimatized NZW rabbits.

Litter Size traits	(σ^2_A) var. Co-var.			(σ^2_P) var. Co-var.			(σ^2_{Pe}) var. Co-var.		
	LSB	**LS21**	**LSW**	**LSB**	**LS21**	**LSW**	**LSB**	**LS21**	**LSW**
LSB	0.149 **(4.06%)**			3.679			0.00003		
LS21	-0.0424	0.016 **(0.94%)**		2.553	4.011		-0.14	0.001	
LSW	0.033	0.0002	0.030 **(1.65%)**	1.840	2.504	3.079	-0.016	-0.99	0.003

+ Traits as definedin Table 1.

Table 3: Heritabilities, genetic correlations, environment error and phenotypic correlations of Litter Size traits for the Acclimatized NZW rabbits.

Heritabilities and genetic correlations				Error (σ^2_e) Co-variance				Phenotypic correlations (r_p)			
Litter Size traits	LSB	LS21	LSW		LSB	LS21	LSW		LSB	LS21	LSW
LSB	0.040			LSB	0.960			LSB	-	0.777***	0.677***
LS21	-0.870	0.0 10		LS21	0.690	0.990		LS21		-	0.851***
LSW	0.490	0.010	0.010	LSW	0.550	0.720	0.990	LSW			-

+ Traits as defined in Table 1.

consuming most of the additive genetic variance. However, Amira El-Deghadi (2019) proclaimed that these low records of h^2_acould be due to greater non-additive genetic factors over additive effects for most doe litter characters.

Genetic correlation (r_g):

The majority of genetic correlation estimates (rg) for traits related to litter size (Table 3) were moderate to low and positive among LSB and LSW (0.490) and among LS21and LSW was low (0.010) high, while genetic correlations among LSB and LS21 was high and negative (-0.870). As a result, we can base our strategy on these features as selection criteria. These results agreement with Amira El-Deghadi (2019) and Fatma Behiry *et al.,* (2021). On the other hand, Abdel-Kafy *et al.,* (2012) attained that, genetic correlations among litter sizes traits were negative r_g except the estimate LSW and LS21. Rabie *et al.,* (2019) who detected a negative r_g between LSB and LSW (-0.29). This negative genetic correlation means that an improvement in one of these traits would result in the deterioration of the other; this was in agreement with Sorhue *et al.,* (2014). Fatma Behiry *et al.,* (2021) reported that, r_g (LSB and LSW) was high (0.89) and positive correlations.

Phenotypic correlations (r_p)

Positive correlation and high between LS traits ranged from 0.677 to 0.851, (Table 3). Similar results were attained by Amira El-Deghadi (2019) and Mahmoud and Walid (2020) on NZW. Positive and highly significant ($P \leq 0.001$). Such traits are primarily influenced by the environment, and the phenotypic parameters reflect the majority of correlation between these traits. In contrast, Fatma Behiry *et al.,* (2021) reported that, the r_p between LSB and LSW was negative (-0.01).

Animal transmitting abilities (TAs):

Animal transmitting abilities, Minimum (Min.), Maximum (Max.), averages and standard deviation (σ_{TA}) as well as number and percentages of the positive records (+) along with the minimum and range of the higher 25% estimates for litter size (LS) traits in NZW rabbits are presented in Table 4. The ranges of the NZW does transmitting abilities (TA) were 0.814, 0.278 and 0.168 bunny for LSB; LS21 and LSW traits, resp. Amira El-Deghadi (2019) reported that the estimated ranges of (TA) for all animals

Table 4: Animal transmitting abilities (TA), minimum (Min.), maximum (Max.), averages and standard deviation (σ_{TA}) of number and percentages of the positive records (+) as well as the minimum and range of the higher 25% estimates for litter size traits in Acclimatized NZW rabbits.

TRAIT	MAX	MIN	Average	σ_{TA}	Range	Total records	Positive records	%	Upper 25%	
									MIN	Average
LSB	0.425	-0.389	0.001	0.1428	0.814	39	19	48.72	0.090	0.335
LS21	0.124	-0.154	0.004	0.0455	0.278	39	19	48.72	0.020	0.104
LSW	0.091	-0.077	0.012	0.0417	0.168	39	22	56.41	0.041	0.050

+ Traits as defined in Table 1.

Table 5: Minimum, maximum, averages and standard deviation (σ_{SE}) of standard error (SE) for Transmitting ability (TA) estimates, as well as minimum and range of the upper 25% of per doe transmitting abilities for Litter size traits of Acclimatized New-Zealand (NZW) rabbits.

TRAIT	Maximum SE	Minimum SE	Average SE	σ_{SE}	RANGE (SE)	Upper 25%	
						Minimum SE	Average SE
LSB	0.370	0.310	0.340	0.0150	0.060	0.310	0.060
LS21	0.120	0.110	0.115	0.0051	0.010	0.110	0.010
LSW	0.170	0.170	0.170	0.0000	0.000	0.170	0.000

+ Traits as defined in Table 1.

were from -0.157 to 0.140 for LSB; -0.553 to 0.903 for LSW. Hanaa *et al.,* (2014) reported that the ranges of (TA) for all animals were 0.22 and 1.80 bunny for LSB and LSW.

They implied that these variations are beneficial and propose possibility of making the most accurate culling decision which may be through selecting for litter size traits from the best rabbit does having the utmost positive transmitting ability appraisals.

The number& percentages of positive records (n+) for the NZW doe data were 19 (48.72%) for LSB; 19 (48.72%) for LS21and 22 (56.41%) for LSW. However, the upper 25% portion of TA data (which is the maximum number of replacement females projected), this means that they are all positive and will contribute favorably to the forthcoming expected selection response (Table 4). These results are comparable to those verified by (Hanaa *et al.,* 2014; Amira El-Deghadi, 2019 and Hassan *et al.,* 2015a & b), and these results are sufficiently eminent enough to permit for genetic improvement bearing in mind that it is anticipated that maximum per year selected-parents for replacement would be about 25%. These results are in agreement with those for litter traits concluded by Hanaa *et al.,* 2014; Amira El-Deghadi, 2019 and Hassan *et al.*, 2015a & b).

Maximum, minimum, averages and standard deviation (σ_{SE}) values of animal standard Errors (SE_{TA}) of the per doe transmitting abilities, along with Minimum and range of the upper 25% TA estimates for litter size (LS) traits in NZW rabbits are presented in Table 5. The ranges of the NZW does SE_{TA} were 0.06, 0.01 and 0.0 for LSB; LS21 and LSW traits, resp. However, the averages of SE_{TA} were 0.340 for LSB; 0.115 for LS21 and 0.170 for LSW. It seems that averages of SE_{TA} were higher at birth and diminishes drastically. After that, making such a choice at a later age might not be as difficult. In this regard, the breeder is more assured in the outcomes of the selection decision and the BLUPs' reliability the lower the SETA values, even if it lengthens the generation intervals (the average age of a sire or dam when a potential replacement progeny is born) due to applying selection on later ages when SE_{TA} were somewhat lower (Hassan *et al.,* 2015a & b).

Table 6 shows the minimum, maximum, averages, and standard deviations (r_{AA}) of animal reliability or accuracies (r_{AA}) of per doe transmitting abilities, as well as the minimum and range of the top 25% TA estimations for litter size (LS) features in NZW rabbits. The ranges of the NZW does r_{AA} were 0.34, 0.31 and 0.19 for LSB; LS21 and LSW traits, rasp. However, the averages of r_{AA} were 0.465 for LSB; 0.418 for LS21 and 0.252 for LSW. It seems that averages of r_{AA} were higher at birth and generally diminishes with advance of bunnies' age. The higher the average accuracies are the easier the selection decision would be. This would be more advantageous when it is highest in earlier ages of bunny's life since this would decrease the generation intervals. According to Hassan *et al*. (2015a& b), the higher the r_{AA} values, the more reliable the BLUPs are and the more confident the breeder is about the results of the selection decision. As a result, generation intervals (the average age of a sire or dam when a potential replacement progeny is born) would be shortened by applying selection at younger ages when r_{AA} was higher.

Table 6: Minimum, maximum, averages and standard deviation (**σ**r_{AA}) of Accuracy (r_{AA}) for transmitting ability (TA) estimates, as well as minimum and range of the upper 25% of per doe transmitting abilities for traits study of Acclimatized NZW rabbits.

TRAIT	Maximum r_{AA}	Minimum r_{AA}	Average r_{AA}	σr_{AA}	RANGE (r_{AA})	Upper 25%	
						Minimum r_{AA}	Average r_{AA}
LSB	0.590	0.250	0.465	0.0807	0.34	0.410	0.180
LS21	0.530	0.220	0.418	0.0730	0.31	0.330	0.200
LSW	0.320	0.130	0.252	0.0467	0.19	0.220	0.100

+ Traits as defined in Table 1

Correlation studies among the breeding values of LS traits (Pearson for BLUP values and Spearman for BLUP rankings).

Estimates of Pearson correlation studies for BLUP's values and for does', Spearman for BLUP ranks, data are presented in table 7. BLUP Pearson correlation between LS traits for doe data were generally negative and highly significant ($P \leq 0.001$) and high to moderate in magnitude except that between LSB and LSW, which was positive and moderate (0.602). Same trend was also observed with Spearman correlation coefficients between LS BLUPs' ranks. The resultant values were also negative and high to moderate in magnitude except that between LSB and LSW (0.699). The high& odd Pearson correlation value between LSB and LSW (i.e. -0.962) is very strange and far from Spearman contemporary value (i.e. -0.368). Of course the Spearman correlation value is more reasonable and close to the expected values of such correlations. The suggested explanation for the former odd value is probably because litter sizes belongs to the countable data and the Spearman correlation coefficients are far better convenient for expressing such type of data, unlike Pearson correlation coefficients which are better in expressing quantitative data.

Table 7: Pearson (Product Moment - above Diagonal: between BLUPs' values) and Spearman (below Diagonal: between BLUPs' ranks) correlation coefficients between litter size traits of Acclimatized NZW rabbits

litter size traits	LSB	LS21	LSW
LSB	1	-0.953***	0.592***
LS21	-0.953***	1	-0.319***
LSW	0.573***	-0.367***	1

+ Traits as defined in Table 1.

Hassan *et al.*, (2015a & b), revealed that the Spearman between litter traits BLUP values or ranks were generally negative in direction and strong. Hanaa *et al.*, (2014) attained that the rank correlation of LSW and LSB were moderate and suggested that litter size at weaning seems to be the most consistent trait that could be used as a selection criterion for improving reproductive performance in rabbits. Amira El-Deghadi, 2019) attained that, the rank correlation of LSW and LSB were moderate (0.480) and highly significant.

The ranks correlations between LS traits in the doe data were generally negative and highly significant (P≤ 0.001) and high to moderate except between both LSB and LSW were positive and moderate (0.573). It, either Spearman between LS BLUP ranks or Pearson between LG BLUP values, were generally negative and high to moderate except between both LSB and LSW were (0.592). Hassan *et al.*, (2015a), revealed that the Spearman between LS BLUP ranks or Pearson between LG BLUP values, were generally negative in direction and strong between both LSB and LSW, and between LS21 and LSW.

Hanaa *et al.*, (2014) assumed that the Spearman correlation between BLUPs' rank of LSB and LSW was highly significant and moderate. They suggested that litter size at weaning appears to be the utmost reliable trait that should be used as a selection criterion for enhancing reproductive performance of rabbit does. Amira El-Deghadi, (2019) reported that rank correlation (*i.e.* Spearman) between LSW and LSB was moderate (0.480) and highly significant. However, these types of correlation are overlapping or interacting as they somehow constitute part-of-all association type. This could complicate the comprehension of the resultant outputs.

Epigenetic Trend (EPG):

Epigenetic trends that are estimated as a deviation from the overall BLUP mean values of the full tested rabbit population for LS traits as influenced by year-season combinations (Y-S) and parity (P) were shown in Figures 1 and 2.

Findings in Figure 1 showed that genetic change of all LS traits', during the first parity were generally positive with varying fluctuating magnitude showing the least value with LS21. However, LS21 show abundant positive magnitude across all parities except that at the fourth one. Conversely, LSW gave persistent negative trends from the second parity through the fourth, but with the highest enormousness extent at the fourth parity. The high NWZ litter size epigenetic trend at the first parity appears to be attributable to a high level of physiological and reproductive maturity development compatibility.

Hassan *et al.*, (2013), on the other hand, found that rabbits perform better at earlier parities, with minor changes amongst rabbit breeds. Findings in Figure 2 showed that LS trait Epigenetic change with (Y-S) effects gave positive trends during the periods with good environmental circumstances, Y-S14 (autumn of the 1st. year 2008) and Y-S 22 (spring of the second year 2009).

The genetic change of the LS21day trait with Y-S effects produced a comparable and positive trend. Y-S11 (winter of the 1st. year) and Y-S23 (spring of the second year), for LSW was Y-S14 (autumn of the 1st. year) that give a step-by-step progressive positive trend, whereas the others give no or negative trends. However, during severe environmental circumstances (Y-S = 11 or winter in the first year as well as Y-S = 23 or summer in the second year), LSB gave negative trends with more deterioration during the cold weather of winter of the first year (11). As for LSW, though showing some sight fluctuation with Y-S combination, but changeability was not severe that it is almost stable. However, for LS21 the status was difficult to comprehend, since it showed the worst performance during the autumn of the first year (Y-S=14).

The explanation for the former situation which may be characterized in most cases with high performance and prolificacy of the bunnies that exploit their adapted acquired performance to express themselves in summer (hot months). The negative (low) LS epigenetic trend of the first year, 2008 as LS21 is hardly comprehensible as the animals are not exploiting their performance that could be due to them being exposed to adverse factors that affect their development and livability, specifically, feeding, and minor infections during the colder months of the year. These findings are largely consistent with those reported by Hassan *et al*., (2013).

These findings are also consistent with those of Hanaa *et al*., (2014), who reported that genetic trend for LSW significantly increased with the advantage of generation number. These may reflect the improving of the performance of NWZ does through increasing their mothering abilities, to take more care of their kits during the suckling period by year.

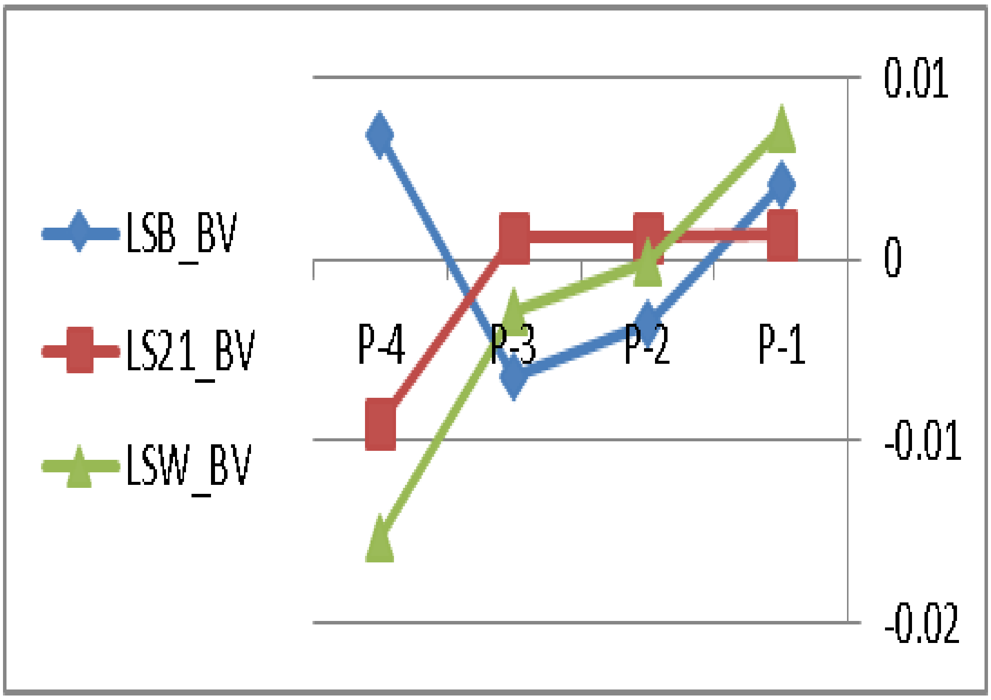

Figure1. The EPG of BLUP values of LS traits in relation to parity.

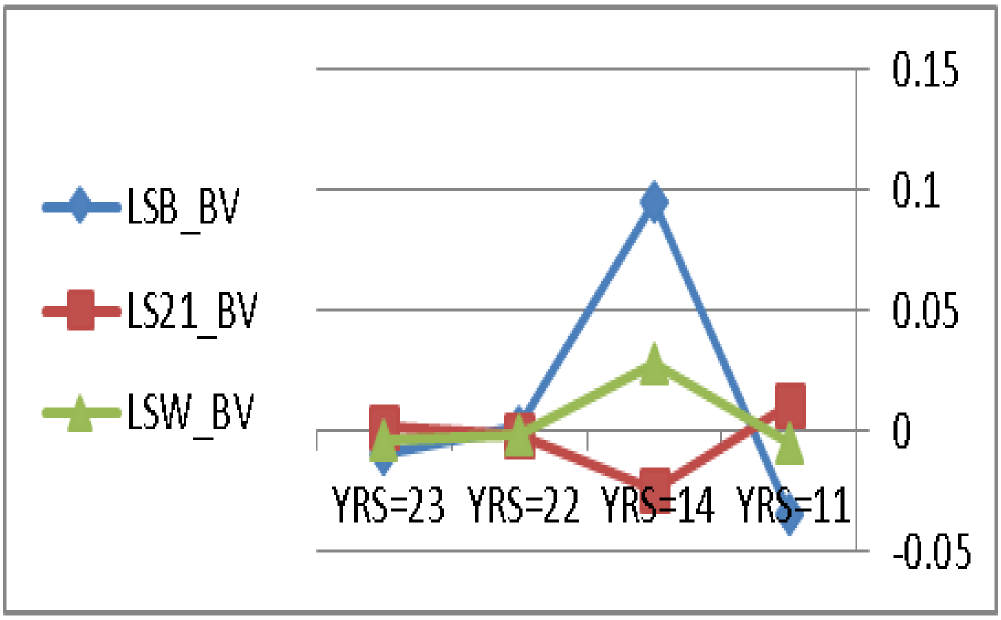

Figure 2. The EPG of BLUP values of LS traits in relation to Year-season.

CONCLUSION:

The heritability of LS traits appears to be too weak to be exploited by individual selection. So, familial or within-family selection would be a solution. A positive correlation between traits related to positive animal records will be dealt to a positive correlation between BLUP traits related to litter size traits, that selection can be made on the traits with the highest breeding value. When the environment is optimal, the biological system expresses its full genetic capacity, as evidenced by epigenetic trends.

REFERENCES

Abdel-Kafy, E. M.; Hassan, N. S.; Morsy, W. A.; Ali Kh, .A. A.; El-Sawy; M. A. and Hassanein, M. N. F.; Sabra, Z. A. M. 2012. Genetic parameters of litter traits in a local Baladi black rabbit in Egypt. *10th World Rabbit Congress – September 3 - 6, 2012– Sharm El-Sheikh –Egypt*, 37-41

Amira, S. El-Deghadi. (2019). Genetic evaluation of some doe, litter and lection traits of New Zealand white rabbits. *Egyptian Journal of Rabbit Science*, 29 (1): 23-43.

Boldman, K. G.; Kriese, A.; Van Vleck, L. D.; Van Tassell, C. P. and Kachman, S. D. 1995. *A manual for use of MTDFREML*. A set of programs to obtain estimates of variances and covariance's [DRAFT]. U.S. Department of Agriculture, *Agricultural Research Service*, USA.

Fatma, M. Behiry; Gharib M.G.; Nabila E. M. El-Kassas and Gamal A. G. Mosalm, (2021). Genetic and some physiological evaluations of doe and body condition traits for the Apri rabbits. *Egypt. Poult. Sci.*, Vol. (41) (I): (229-248)

Fayeye, T. R. and Ayorinde, K. L. (2016). Heritability and Repeatability Estimates for Birth and Weaning Characteristics in Domestic Rabbit. *International Journal of Agricultural and Veterinary Sciences*, 2(1): 11.

Hanaa, A. Moustafa; El-Raffa, A.; Shebl, M. K.; El-Delebshany, A. and Nadia A. El-Sayed. (2014). Genetic Evaluation of some economic traits in a maternal line of rabbits. *Egypt. Poultry Sci.*, 34 (I): (85-98) (1486).

Hassan, N. S.; Abdel-Ghany A. M.; Hanan H. Ghanem; M. A. El-Shennawy and Mona M. Ghaly. (2013). Genetic evaluation of the native Baladi Black rabbits under North Delta Weather of Egypt using Animal Model procedure. A: Doe litter traits. *Journal of Animal, Poultry & Fish Production, Suez Canal University,* Vol. (1), 2013: 13-22.

Hassan, N. S.; Sabra, Z. A. M.; El-Deghaidi, A. S. and Morsy, W. A. (2015a).Genetic Parameters of Litter Gain traits of APRI line Rabbits. *Egyptian Journal of Animal Production*, 52, Suppl. Issue, April (2015): 127-135.

Hassan, N. S., Abdel-Ghany, A. M. and Sabri, H. M. (2015b). Genetic Parameters of the Newly Developed Egyptian APRI Rabbit Line Raised Under North Delta Environment Using DFREML Animal Model 1 Litter Weight traits. EC. *Veterinary Science*, 1(1): 30 46.

Hebert, D.; Faure, S. and Olivieri, I. (1994). Genetic, phenotypic, and environmental correlations in black medic, Medicagolupulina L., grown in three different environments. *TheorAppl Genet* , 88:604-613

Legates, J. E., and R. M. Myers. (1988). Measuring genetic change in a dairy herd using a control population. *J. Dairy Sci*., 71:1025–1033.

Mahmoud, M. El-Attrouny and Walid S. Habashy. (2020). Correlated response on litter traits and milk yield in New Zealand White rabbits selected for litter size at birth. *Egypt. Poultry Science,* Vol. (40) (III): 599-612.

Montes-Vergara, D. E.; Hernndez-Herrera, D.Y. and Hurtado-Lugo, N. A. (2021). Genetic parameters of growth traits and carcass weight of New Zealand white rabbits in a tropical dry forest area. J. *Adv. Vet. Anim. Res.*, 8(3): 471–478, September 2021.

Rabie, T. S. K.; Nowier, A. M.; Abou-Zeid, A. E. and Khattab, A.S. (2019).Impact of crossing between Gabali and V–line rabbits on the pre-weaning traits by using tri diagonal and genetic merit methods. *Egyptian Poultry Science,* 39:519- 536.

SAS. (2003). SAS Online Doc 9.13 SAS Institute Inc. Cary, NC, USA.

Sorhue, U.G.; Mmereole, F. U. C.B; Irikefe-Ekeke, E. P. C; Wakwo, U. N. S. (2014). Genetic analysis of some economic traits in a composite breed of domestic rabbits reared in a tropical environment. *Nigerian Journal of Genetic*, Volume 28, Issuez, July: 34-37. (2014).

Zaharaddeen, M. M. and Kabir, M. (2018). Repeatability Estimates and Principal Component Analysis of Birth and Weaning Traits in Domestic Rabbits. *International Journal of Research in Agriculture and Forestry,* Vol. (5), IS 4, 7-12. 2018.

المقاييس الوراثية ودرجة تأثر الأداء الوراثى (التعبير الجيني) لصفات حجم البطن للأرانب النيوزيلندي البيضاء المتأقلمة للظروف المناخية فى مصر

ناجى سعيد حسن[١] ،احمد محمود عبدالغنى احمد[٢] ، صفاء صلاح سند[١] ، حسن عبد الكريم حسن عبدالحليم[١] ، محمود غريب غريب[١]

[١]معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، وزارة الزراعة، الجيزة- مصر.

[٢]قسم الانتاج الحيواني - كلية الزراعة-جامعة قناة السويس –الاسماعيلية –مصر.

تم تحليل بيانات 93 بطن تم إنتاجها من 36 انثى منسبة لعدد ١٣ ام و ٩ اباء ذكور ، باستخدام نموذج الحيوان متعدد الصفات (MTDFREML). الصفات التي تم تقييمهاهى (حجم البطن للأنثى عند الولادة (LSB) - عند عمر ٢١ يومًا (LS21) وعند الفطام (LSW) عند ٣٥ يومًا من العمر)، علي مدار عامين إنتاجيتين متتاليتين. هذا وقد كانت تقديرات قيم المكافئ الوراثى لجميع صفات حجم البطن منخفضة، بينما كانت قيم الارتباط الوراثي بين صفة

حجم البطن عند الولادة وحجم البطن عند الفطام متوسطة وإيجابية (٠.٤٩٠). بالنسبة لقيم المقدرة الانتقالية (لبنات) أرانب النيوزيلاندى –المتأقلمة تحت الظروف المناخية المصرية ، فقد كان المدى لهذه القيم 0.814، ٠.٢٧٨ و٠.١٦٨ أرنب لصفة حجم البطن عند الولادة، عند عمر ٢١ يومًا وعند الفطام (عند عمر ٣٥ يومًا) على التوالي. وعند تقييم الارتباط بين قيم المقدرة الانتقالية BLUPs باستخدام أى من بيرسون أوسبيرمان، فقد وجد أن القيم الناتجة كانت متقاربة جدا ومعتدلة ومناظرة للإرتباط الوراثى المحسوب بالبرنامج MTDFREML. وبالنظر للنتائج الأخيرة فيمكن الإعتقاد أن أى من هذين النوعين من حساب الارتباط، يمكنه أن يقدم بديلًا للتقدير التقريبى للارتباط الوراثى الفعلي لصفات حجم البطن خاصة في الحالات ذات الحسابات المعقدة أو الغير ممكنة.

أما بالنسبة لدرجة تأثر الأداء الوراثى/التعبير الجيني (EPG) بالظروف البيئية المحيطة (مثل ترتيب البطن أو التوافقيات بين السنة وموسم الولادة). ففيما يتعلق بتأثير ترتيب البطن، كانت أعلى استجابة لصفات حجم البطن هو البطن الاولى حيث الرعاية الكاملة من خلآل الأم. أظهرت أيضا صفات حجم البطن أن درجة تأثر الأداء الوراثى لها مع تأثير التوافقيات بين السنة وموسم الولادة (Y-S) قد أعطت أيضا اتجاهات إيجابية أفضل خلال الظروف البيئية الجيدة. هذه النتائج الأخيرة أدت إلى الإعتقاد بأن درجة تأثر الأداء الوراثى/التعبير الجيني (EPG) بالظروف البيئية المحيطة مثل ترتيب البطن أو تأثير التوافقيات بين السنة وموسم الولادة يمكن أن يتغير من تأثير بيئى إلى آخر.

التوصية: توصي هذه الدراسة بإعطاء الأرانب النيوزيلندية المتأقلمة في مصر مزيدًا من الاهتمام والتحسين الوراثي من خلال الانتخاب للوصول إلى أداء السلالة القياسية خاصةً مع للكميات الكبيرة من المكون الوراثى غير الإضافي لهذه الصفات.