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NEW ZEALANDWHITE RABBITS' BLUP VALUES FOR POST-WEANING INDIVIDUAL BODY WEIGHT UNDER EGYPTIAN CONDITIONS

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ABSTRACT

Genetic parameters of New Zealand White (NZW) growth traits were estimated, using Multi-Trait Derivative-Free Restricted Maximum Likelihood (DFREML). A total of 962 individual live body weight at 5 (W5), 8 (W8) and 10 (W10) weeks of age were considered for the evaluation. The animal model analysis included parity (P), sex (S) and year season (YrS) as fixed effects as well as animals and common litter as random effects. Heritabilities of considered body weights were somewhat moderate being 0.23, 0.36 and 0.38 for W5, W8 and W10, respectively. Common litter effects were low but 10 times higher for weights at earlier ages W5 and W8 (0.007) than that for later ones W10 (0.0007). The ranges for the top 30 % ranked sires were 63 g., 48 g., and 62 g. for W5, W8 and W10, respectively. However, it were 71 g., 57 g. and 70 g. for the top 30 % ranked dams. The product moment correlation coefficient concerning sire breeding value and the spearman correlation coefficient concerning ranks of sire breeding value was lower for coefficients between 5 and 8 weeks compared with the higher and significant ones between 8 and 10 weeks of age. The accuracies ($r_{a\hat{a}}$) of minimum and maximum estimates of predicted breeding vale (PBV) were mostly higher in W8 (71 to 73%) than W5 (60 to 68%) and W10 (58 to 68%).

Key words: breeding values, heritability, correlation.

INTRODUCTION

Selection for growth rate has been performed in the New Zealand White (NZW) rabbit to meet demands of rabbit. Accurate determination of rabbits' individual breeding values for such an economic trait is fundamental for planning and attaining progress in breeding programs (Abdel-Ghany, *et al*. 2003). In this respect, Best Linear Unbiased Prediction (BLUP) estimated by different procedures is a reliable approach to predict breeding values of animals and to adjust simultaneously for fixed effects of the model (Lukefahr, 1992).

The objectives of the present study were to estimate the variance component, heritabilities and BLUP values of growth traits, using REML procedures with multiple trait animal model.

MATERIAL AND METHODS

Herd and data

Individual body weight, at 5 (W5), 8 (W8) and 10 (W10) weeks of age of New Zealand White (NZW) rabbits were collected from 962 individuals sired by 18 sires. Data were collected during the years 2002 and 2003 from Sakha Research Station, Animal Production Research Institute, Ministry of Agriculture, Kafr-El-Sheikh Governorate, Egypt.

Animals were fed on a pelleted ration which contained approximately 18 % crude protein, 2800 kcal metabolizable energy per kg diet. Feed and water were provided *ad libitum.* Breeding does and bucks of NZW rabbits were housed separately in individual wired-cages arranged in double tire. Random mating (Panmexia) avoiding full and half sib matings was, practiced. Litters were weaned mostly at the age of 35 days. At weaning each bunny was individually ear tagged. The growing rabbits were raised intermingled in collective cages (6 individuals / cage). All the herd was kept under the same managerial and environmental conditions

Statistical analysis

W5, W8 and W10 for 962, 855 and 809 rabbits were recorded, respectively. Starting (guessed) variance and covariance values, were obtained by **REML** method of **VARCOMP** procedure (SAS, 1988) to be used for the estimation of the more precise and reliable estimates of multi-trait animal model variance and covariance components. The structure of the data analyzed is shown in table 1.

Table 1. Structure of New Zealand White rabbits' data analyzed in, at 5, 8 and 10 weeks of age.

No. of sires	18
No. of dams	74
No. of animals weaned	962
Total number of animals in the pedigree file	1056

The following animal model was used

$$y = Xb + Z_a u_a + Z_c u_c + e$$

where

y = vector of observations on animal; b = vector of unknown fixed effects peculiar to parity, sex and year-season (5, 2 and 5 levels respectively) as well as litter size at birth as a covariate; u_a = vector of random additive genetic effect of the animal for the i^{th} trait; u_c = vector of random common litter effect (dam x parity combination); **e**= vector of random error; X, Z_a and Z_c are incidence matrices relating records of ith trait to the fixed, random animal and random common litter effects, respectively

Occurrence of local maxima was checked by repeatedly restarting the analyses until the log-likelihood did not change beyond the fourth decimal. The Multi-trait Animal Model (**MTAM)** was used to estimate additive genic, common litter effect, error, co-variance matrices and heritability.

Predicted breeding values (PBV)

The (co)variances estimated using **MTAM** analysis were used for the prediction of breeding values, standard errors and its accuracies ($r_{a\hat{a}}$).

The accuracy of **PBV** for each individual was estimated according to Henderson (1973) as:

$$r_{A\hat{A}} = \sqrt{1+\mathrm{F}_j \text{ -}\mathrm{d}_\mathrm{j}\alpha}_a$$

where $r_{A\hat{A}}$= the accuracy of prediction of the ith animal's breeding value; F_j= inbreeding coefficient of animals (assumed equal to be zero); d_j= the jth diagonal element of inverse of the appropriate block coefficient matrix; and $\alpha_a = \sigma^2_e/\sigma^2_a$.
Standard errors of predicted breeding values ($s.e._p$) were estimated for each individual as: $s.e._p = \quad d_j\sigma_e^2$ **; where** d_j and σ^2_e were defined before**.**

RESULTS AND DISCUSSION

Additive genetic variance

Variance components [direct additive genetic(σ_a^2), common litter effect (σ_c^2), error (σ_e^2) and phenotypic (σ_p^2)] and heritabilities for body weights in **NZW** rabbits at 5, 8 and 10 weeks of age are presented in Table 2. The additive genetic variances constituted 23.0 – 37.40 % of the phenotypic variance. Khalil *et al*. (2000) reported comparable magnitude of the additive genetic variance with an average of 31.7 %. These results indicate that improvement of body weights in the evaluated herd is reasonably possible through individual selection. The percentage of direct additive genetic variance was higher at (8 and10 wks) than that at (5 wks.). This indicated that selection in the herd under consideration, preferably (though of the elongated generation interval) may be made during earlier ages after weaning, to allow individuals to express their full potential.

The relative low magnitude of the additive genetic variance at 5 wks. Of age is quite agreeable with SU *et al*. (1999), which could be attributed to the rather high common litter effect variance at this age

Common litter effect variance

Variances of common litter effect (σ_c^2) at 5, 8 and 10 weeks of age recorded an average of 15.5 % (Table 2). The estimate of σ_c^2 was the highest for body weight at 5 weeks, this may be due to mothering ability, which is continued to the end of suckling period. Iraqi *et al*. 2002 reported a large maternal and/or common environmental effects at 8 wks of age , and indicated that this finding due to since individuals in the same litter being nursed by the same dam and reared in the same cage. Estimates of σ_c^2 for body weight at 8 and 10 weeks of age were of low or moderate , this may be due to , that bunnies started to have its expression along with increasing it variances and also declining the effects of mothering ability.s

Heritability

Heritability estimates (h_a^2) for body weight (Table 2) at 5 wks. of age was of low estimate, while it recorded a moderate estimates at 8 and 10 wks. of age .This findings may be due to the weaning rabbit start to depend upon it self to express its performance , and express his sire effect along with disappearing his mothering ability effects. Small or moderate estimates of heritability for post weaning traits may be attributed to the small size of progeny/generation (FERRAZ *et al*. 1992 and KHALIL *et al*. 1993).

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Table 2. Variances components estimates [direct additive genetic (σ_a^2), common litter effect (σ_c^2), error (σ_e^2) and phenotypic (σ_p^2)], heritabilities (h_a^2).

Trait	σ_a^2	%	σ_c^2	%	σ_e^2	%	σ_p^2	h_a^2 ± SE.
BW5	.0038	23.03	.0067	40.6	.006	36.4	.0165	.2±.08
BW8	.0028	35.4	.00002	.0002	.0051	64.5	.0079	.4±.07
BW10	.0043	37.4	.0007	6.1	.0009	56.5	.0115	.4± .08

Transmitting ability

Sire transmitting ability

Considering all sires, the minimum and maximum growth traits estimates of sire breeding values (SBV) at 5, 8 and 10 wks of age presented in table 3., revealed that there is no a consistent trend among the three ages studied, that the ranges of SBV were in general higher at 5 and 10 wks than at 8 wks of age, that there were 8 sires representing 44.4 % showed an absolute difference of 63 g. at 5 weeks, 11 sires (61.1 %) showed an absolute difference of 48 g. at 8 weeks and 10 sires (55.5 %) of 62 g. body weight. KHALIL *et al*. 2000 observe the same trend that percentage of sires with positive estimates of STA ranged from 46.2 to 61.0 % for body weights at 5,6,8 wks of age. These results revealed that NZW rabbits would respond to selection better at weaning at 5 wks of age and at 10 wks of age than at 8 wks of age.

Table 3). Minimum and maximum estimates and its standard errors (SE), and the range (grams) of Sire transmitting abilities (SBV) along with SBV of the superior 30% sires and the number (No.) and percentage R of sires that possess positive SBV for body weight at 5, 8 and 10 wks of age in New Zealand White rabbits.

Trait	No.	SBV of all sires used					SBV of the top 30%			+ Records	
		Min.	R	Max.	R	Range	Min.	R	Range	N	%
BW5	18	-.057±.05	.67	.09±.05	.68	.147	.027±.03	.85	.063	8	44.44
BW8	18	-.036±.03	.77	.061±.03	.81	.097	.013±.02	.89	.048	11	61.11
BW10	18	-.067±.04	.77	.079±.04	.81	.146	.017±.03	.88	.062	10	55.55

However, the data in table 3 exhibited an obvious trend concerning the percentage of sires that possess positive values % , which is that NZW rabbits at 8 wks of age had a higher % compared with respectives of NZW rabbits at 5 and 10wks of age. When considering the top 30 % of sires , we can find that the differences between maximum and minimum values in STA were smaller than that when considering all the sire list. These results agree with KHALIL *et al*. (2000). Our latter results reveal that delaying of selection, although it extended the generation interval, may give a better relative response. from a genetic point of view there is considerable potential for an improvement of body weight specially at later ages through sire's selection arising from the body weight exhibited among sires (HASSAN 1995).

Dam transmitting ability

In the data of all dams, the minimum and maximum growth traits estimates of dams breeding values (SBV) at 5, 8 and 10 wks of age presented in table 4. The differences between maximum and minimum BV. Were increase with the advancement of age. that there were 33 dams representing 44.5 & showed an absolute difference of 71 g. at weaning at 5 weeks, 42 dams (56.7 %) showed an absolute difference of 57 g. at 8 weeks and 36 dams (48.6 %) with an absolute difference of 70 g. body weight, Using the Animal Model, Hassan (1995) agree with these findings at weaning. Compare with our results, the absolute differences estimated by ZEIN EL-ABEDIN (1998) were low for both, the all dams (137.8, 143.6 and 214.5) and for the top 30 % (63.6, 67.2 and 81.2) at the same ages studied. He added that the Animal Model have somewhat different trend relative to the Dam model in the evaluation of dams for post weaning growth traits of NZW rabbits raised in Egypt.
These results revealed that NZW rabbits would respond to selection better at earlier ages. However, in the 30 % top dams, we observed that the percentage of dams that possess positive values at 8 was higher when 5 and 10 weeks of age was higher than at the other two ages. When considering the top 30 % of dams, we can find that the differences between maximum and minimum values in DTA were smaller than that when considering the all dams list. These results agree with ZEIN EL-ABEDIN (1998). From a

genetic point of view there is considerable potential for an improvement of body weight specially at earlier ages through dam's selection.

Table 4. Minimum and maximum estimates and its standard errors (SE), and the range (grams) of Dams transmitting abilities (DBV) along with DBV of the superior 30% dams and the number (No.) and percentage (R) of dams that possess positive DBV for body weight at 5, 8 and 10 wks of age in New Zealand White rabbits.

Trait	No.	SBV of all sires used					SBV of the top 30%			+ Records	
		Min.	R	Max.	R	Range	Min.	R	Range	n	%
BW5	74	-0.085±.05	.65	.081±.05	0.47	166	.010±.05	0.56	71	33	44.595
BW8	74	-0.120±.04	.59	.082±.03	0.78	202	.025±.04	0.73	57	42	56.757
BW10	74	-0.191±.05	.58	.98 ± .04	0.74	289	.028±.05	0.63	70	36	48.649

Product moment correlation coefficient

Across all traits, the product moment correlation coefficients (SAS, 1988), among sires and dams and its rank's according to their transmitting abilities, presented in table 5 , were highly significant and positive, except the correlation estimates between BV at 5 and 10 weeks of age. The same trend was observed in all Rank correlations estimates among the ranks of the growth traits.
In this respect, the rank correlation studies should focus on the top and bottom 5% portion of the data, since they will be the selected and the culled animals, respectively. This of course requires a large set of data to be evaluated.

Table 5. BLUP Correlations and rank correlation estimates among the breeding values of the growth traits (BV5, BV8 and BV10) through sire's data.

	Trait	Correlation		Trait	Rank	
		BV8	BV10		Ran8	Ran10
Sires	BV5	0.125	-0.34	Ran8	0.137	-0.337
	BV8		0.791***	Ran10		0.793***
dams	BV5	0.27	-0.327***	Ran8	0.33	0.217***
	BV8		0.89***	Ran10		0.738

CONCLUSION

We can concluded that, there is considerable potential for an improvement of body weight of NZW rabbits in Egypt specially at earlier ages through sires and dam's selection.

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