U.A.R., J. Anim. Prod. Vol. **10**, No. 1, pp. 65–72 (1970).

GENETIC AND PHENOTYPIC PARAMETERS FOR THE IMPROVEMENT OF BODY WEIGHT IN GIZA RABBITS

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This work was carried out in the experimental Farm of the Animal and Poultry Breeding Department, Faculty of Agriculture, Cairo University, Giza.

Twenty six pedigree-mated families (one buck for each five does) were constructed. Prognenies were weighed at 30 days of age then at 15 days intervals till 90 days of age. Heritability, genetic and phenotypic correlations were estimated for the live body weight at different ages. The main results obtained are summarised as follows:

The average body was nearly two and three times the initail 30 days weight at 60 and 90 days of age respectively (312.23, 524.40 and 989.12 grams for the three respective ages).

The heritability estimates (h^2_{s+d}) for body weight at 4, 6, 8, 10 and 12 weeks of age, based on analysis of variance method, were .58, .35, .57, .58 and .28 respectively.

The values of the genetic correlations between body weights tend to decrease as the differences between the ages get larger, the genetic correlations showed also more uniformity than the phenotypic ones.

Growth is one of the complicated characteristes sought by the animal breeder. It could be expressed in different ways. It could be taken as the absolute weight, the difference between successive weights, as relative growth rate, or as percentage of a certain early weight.

The study of the phenomenon of growth of farm animals is mainly restricted to the stage in which the breeder is intersted. Rabbits are supposed to be slaughtered at a certain age, this is defined as the age in which the breeder can get the highest economic gain.

Materials and Methods

This work was carried out in the Animal and Poultry Breeding Farm, Faculty of Agriculture, Cairo University, Giza, during the season 1965 - 1966, using Giza breed. The number of animals used through the breeding season was 130 does and 26 bucks, each buck serving 5 does during the whole season.

The rabbits were fed three times daily, the morning meal was usually composed of clover hay. Berseem (Trifolium alexandrinum) was offered at

mid-day. The evening meal ration consisted of 50 barely + 50% wheat bran. In summer, green corn-stock wes replaced berseem.

The total number of rabbits born in the season was 2912 individuals. Progenies were weighed at 30 days of age (at weaning) then at 15 days-intervals till 90 days of age.

Methods of Analysis

In estimating the heritability of body weight at different ages, full and half-sib analysis was performed by the method discribed by Falconer (1961).

The genetic and phenotypic correlations were estimated according to the formulae given by Falconer (1961). The same methods for estimating heritability were adopted to estimate the genetic correlations between the different traits.

Growth characters:

Table 1 show the absolute body weights of males and females during the period of study. It could be seen that the live weight of the animals progressively increase with age. The differences between the two sexes are of very small magnitudes, indicating that sex has almost no effect on the weights at the ages studied. This is in agreement with Wilson (1930 & 1932), Hammond (1932), on different foreign breeds of rabbits, and Kheir El-Din (1950), El-Khishen *et al.* (1951), Ragab *et al.* (1952), Wanis (1958) and Hanafi (1959) on Giza rabbits.

TABLE 1.—THE AVERAGE BODY WEIGHTS OF GIZA RABBITS AT THE FIVE AGES STUDIED

Age in days	Sex	Number	Average body weight ± (grams)
30	Male	795	314.98
	Female	707	311.26
45	Male	498	505.40
	Female	531	503.73
60	Male	369	658.50
	Female	351	615.79
75	Male	289	813.79
	Female	302	780.28
90	Male	251	994.93
	Female	248	985.19

Table 2 show the weights at the different ages, relative to the weight at 30 days of age. It could be seen that the animals doubled their weights at 60 days of age. At 90 days of age, the rabbits had more than tripled their weights. These results are in agreement with Kheir, El-Din (1950), Wanis (1958) and Hanafi (1959) for the Giza breed.

TABLE 2.—RELATIVE BODY WEIGHT OF GIZA RABBITS AT DIFFERENT AGES COMPARED TO THEIR WEIGHTS AT 30 DAYS OF AGE

Age in days	Sex	Body weight in gains	Percentage to weight at 30 days of age
30	Male	314.98	100.00
	Female	311.26	100.00
45	Male	505.40	160.45
	Female	503.73	161.83
60	Male	658.60	209.06
	Female	615.79	197.83
75	Male	813.79	285.36
	Female	780.28	250.68
90	Male	994.93	315.87
	Female	985.14	316.51

Heritability of body weights:

Table 3 shows that the heritability estimates (h^2) of body weight at 4 weeks of age (weaning weight) was 0.178 as obtained from paternal components of variance and 0.931 as obtained from maternal components. The combined estimate was 0.558 (Table 3). No estimates of heritabilities for this character on rabbits were found in literature. However, figures on mice and pigs are available. Hull (1960) estimated a higher heritability for weaning weight (0.74), while others found lower heritabilities for the same character (Falconer, 1953, (.35) and Rahnefeld *et al.* (1962), (.21). In pigs, Sviben (1965) found that the heritability of the same character was .16.

The heritability estimates of body weight at 6 weeks of age, obtained from paternal, maternal and both components of variance were, 0.185, 0.529 and 0.357 respectively. (Table 3). Falconer (1953) estimated the heritability of body weight at 6 weeks of age for mice, and found it to be 0.35, almost the same as the combined estimate of this study.

The values obtained for the heritability of body weight at 8 weeks of age were, 0.225, 0.929 and 0.578 for h^2_s, h^2_d and $h^2_{(s+d)}$ respectively. The corresponding figures for body weight at 10 weeks of age (Table 3) were 0.150, 1.00 and 0.557 respectively, and those for body weight at 12 weeks of age were, 0.001, 0.562 and 0.281 respectively.

In all these characters the dam components of variance are higher than the sire's, and consequently all the h^2_d are greater than h^2_s. This might indicate maternal effect in body weight at these early ages. The dam component includes all the variance due to maternal effects plus one quarter of that due to dominance, and a small fraction due to epistasis. It is usual, therfore, to conclude that if the dam component is larger than the sire component, this is due to maternal effect and possibly dominance, i.e. nonadditive genetic variance. It must be remembered however, that the selection differential is usually smaller with the female than the male when selecting the parents for the next generation, and this may limit the variation shown between sires, in comparison with that shown between dams. Sampling effect may also play a large part in the excess of the estimation of h^2 from the dam component over that computed from the sire component. This could account for the great differences between sire and dam components.

Inter-relationships between body weights:

The estimates of the phenotypic correlation (r_p) between the traits measured are summarized in Table (4). The phenotypic correlations between the body weights at different ages were all positive. The correlation coefficients obtained in this study are very close to those obtained by Hanafi (1959) on Giza rabbits and t those obtained by Blum and Wiley (1954), Katats *et al.*, (1961) and Juszcak and Poznanski (1962) on pigs.

TABLE 3.—HERITABILITY OF BODY WEIGHTS AT THE FIVE AGES STUDIED

Traits	Sire Estimate h^2_s	Dam Estimate h^2_d	Combined Estimate h^2_{s+d}
4 wk.	0.178	0.931	0.558
6 wk.	0.185	0.529	0.357
8 wk.	0.226	0.929	0.578
10 wk.	0.150	1.00	0.575
12 wk.	0.001	0.562	0.281

The highest correlation coefficient (r_p) found in this study was that between the body weight at 6 and 10 weeks age. Such high relationships were also reported by Hanafi (1959) (r = .921) on Giza rabbits, Blunn and Baker (1949) (r = 0.63) and Kalats (1961) (r = .92) on pigs.

(The lowest valie of (r_p) was that between the body weight at 4 and 12 weeks of age (r = .316). Hanafi (1959) reported a correlation of 0.38 for the same ages. However, it is admitted that the phenotypic correlation is not a satisfactory guide to the expected correlated genetic responses of characters under selection, the genetic correlstion is the one to be used for such prediction.

Genetic correlations between body weights:

The estimates of the genetic correlations, between body weights at different ages are found in Table (4).

Table (4) shows that all the genetic correlations between body weights are positive, and tend to decrease in value as the differences between the two ages get larger. These correlation showed also more uniformity than the phenotypic ones. This fact offers a good help for the breeder to select for body weight in the Giza rabbits at earlier ages.

TABLE 4.—SUMMARY OF THE GENETIC AND PHENOTYPIC PARAMETERS OF BODY WEIGHT*

Traits	Weight at 4 wk.	Weight at 6 wk.	Weight at 8 wk.	Weight at 10 wk.	Weight at 12 wk.	D. F.
Weight at 4 wk. . .	—	.769	.717	.501	.455	1501
Weight at 6 wk. .	.760	—	.496	.504	.448	1028
Weight at 8 wk. .	.547	.615	—	.586	.332	719
Weight at 10 wk. .	.569	1.00**	.831	—	.641	590
Weight at 12 wk. .	.316	.628	.757	.872	—	498

* Figures above diagenal represent the genetic correlation. Figures under diagenal represent the phenotypic correlation.

** Figures were considered to be 1 if the calculated correlation was more than that.

Expected carrelated response to selaction :

It has been shown that the heritability of body weight at 4 weels of age in based on sire and dam components of variance, exceeds that of body

weight at 12 weeks of age, The latter character being the one sought by the breeder. However, the genetic correlation between body weight at 4 and 12 weeks was equal to .455. The importance of the genetic correlation could be considered if we compute the genetic progress when selecting directly on the basis of body weight at 12 weeks of age with that obtained from selecting for the highly correlated character, *i.e.*, body weight at 4 weeks.

The expected genetic progress for character I, when selecting directly for it, will be $\Delta g_1 = i\sigma g_1 h_1$ (i being the selection intensity). The expected genetic progress in character I when selecting for character 2 will be equal to the genetic progress in character 2 multiplied by the genetic regression of character I on 2, i.e. $\Delta g_1 = i h_2 rg \sigma g_1$.

The comparison between the two methods when using the same intensity of selection, will then be between h_1 and h_2 rg. If we try to use body weight at 12 weeks of age as character I, and body weight at 4 weeks of age as character 2, then the comparison will be between :

$$\sqrt{.2873} \quad : \quad \sqrt{.550} \times .455$$

$$0.529 \quad : \quad 0.337$$

The relative progress is thus 0.63. The same conclusion was found by Hanafi (1959) in Giza rabbits, who found that there was a highly and significant correlation between body weight at different ages. Also he stated that this fact offers a good help for the breeder to select for body weight in the rabbits at earlier ages. Therefore, it could be safely concluded that on the grounds of the genetic correlations obtained, that body weight at weaning could be used for selection and improvement of body at 90 days of age.

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المؤشرات الوراثية والمظهرية لتحسين وزن الجسم فى أرنب الجيزة لأبيض

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الملخص

تناول هذا البحث بالتحليل أوزان الأرانب الناتجة من ست عائلات منسبة كل عائلة منها كانت تشتمل على ذكر وخمس اناث . تم وزن نسلها فى عمر ٣٠ يوما ثم كل ١٥ يوما بعد ذلك حتى عمر الـ ٩٠ يوما . وقد قدرت القيمة الوراثية ومعامل التلازم الوراثى والمظهرى بين الأوزان المختلفة فى الأعمار السابقة الذكر وقد تبين من التحليل والدراسة أن متوسط الوزن فى عمر ٣٠ يوما هو ٣١٢ر٢٣ جم وفى عمر ٦٠ يوما ٥٢٤ر٤٠ جم وفى عمر ٩٠ يوما ٩٨٩ر١٢ جراما . كما كانت القيمة الوراثية على متوسط الآباء لوزن الجسم فى ٤ ، ٦ ، ٨ ، ١٠ ، ١٢ أسبوعا هى ٥٨ر ، ٣٥ر ، ٥٧ر ، ٥٨ر ، ٢٨ر ، على التوالى كما اتضح أيضا أن معاملات التلازم الوراثية بين أوزان الجسم المختلفة تتجه الى النقصان كلما كانت الفروق فى الأعمار أكبر . هذا كما كانت تقديرات معاملات التلازم الوراثية أكثر تجانسا من معاملات التلازم المظهرية .