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ESTIMATION OF GENETIC PARAMETERS WHEN THE COMMON ENVIRONMENTAL EFFECT IS IGNORED OR CONSIDERED IN THE ANIMAL MODEL FOR PRODUCTIVE TRAITS IN BROAD BREASTED BRONZE TURKEY

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ABSTRACT: *Genetic parameters were predicted using uni-trait animal model with ignored and considered the effect of common environment (σ_c^2). A total number of 444 males and 497 females of Broad Breasted Bronze (BBB) Turkey were used in this study. Live body weights (LBW) from hatch up to 24 weeks of age were studied. Shank length (SL) and keel length (KL) at 16, 20 and 24 weeks of age were also studied. Results show that percentages of additive genetic variance (σ_a^2) for LBW traits at early ages in males were lower (52% at hatch) than later ages (75% at 24 weeks), while the reverse trend (62% and 56% for LBW at hatch and 20 weeks of age, respectively) was obtained in females when ignoring the effect of σ_c^2 in the model. Percentages of σ_a^2 for LBW traits in males were low when the effect of σ_c^2 is considered in the model compared to those obtained when ignored that effect. Percentages of σ_c^2 were high for LBW at hatch (39%) and then decreased gradually as the males get older, but in females, these percentages were zeros for most studied traits. Bias in estimates of σ_a^2 (when ignoring the effect of σ_c^2 in the model) was very high (99.99%) for LBW trait at hatch in males and then decreased thereafter as the males get older (0.16% for LBW at 24 weeks). When ignoring the effect of σ_c^2 in the model, Heritability (h_a^2) estimates were high for all studied traits in males compared to those in females. For birds with records (progrny), when ignoring the effect of σ_c^2 in the model, the ranges in predicted breeding values (PBV) for males ranged from 13.80 to*

Turkey, Growth traits, Heritability, Breeding values, Animal model.

4491.93 grams for LBW, 0.002 to 17.08 mm for SL traits, and 27.37 to 34.86 mm for KL traits, while the respective values in females ranged from 0.0 to 1812.13 grams, 0.002 to 31.12 mm, and 0.003 to 16.123 mm for the same traits. When ignoring the effect of σ_c^2 *in the model, the average of accuracy (*$r_{A\hat{A}}$*) across all the minimum and maximum of PBV for all studied traits in males was higher than those in females. Estimates of simple genetic correlations (*r_G*) among predictors for most of growth traits in males and females of BBB were ranged from low to high (but in general being high) and significantly positive.*

INTRODUCTION

In Egypt, meat production of Turkey represented 2% of the total poultry production. Turkey production needs more research works considering with the reduction of its costs followed by a relative decrease in the price.

A genetic evaluation of breeding stocks required the knowledge of phenotypic and genetic co(variance). The adoption of mixed model methodologies by the poultry breeders would require the demonstration of quantifiable benefits such as extra genetic gain to justify the cost implementation (Jeyaruban et al., 1995). Iraqi (1999) reported that animal model is the standard model for genetic evaluation of poultry flocks today. He concluded that applying single- or multi- traits animal model in evaluation allows estimation of additive genetic variance without bias. Furthermore, with animal model, the inclusion of common environmental effect allows obtaining the true estimates of additive genetic variance (Falconer and Mackay, 1996; Mrode, 1996). Also, even in an animal model, if maternal effects are present but not accounted correctly, estimated additive direct variance from dam component will also include all or part of the maternal variance.

In Egypt, no works are published on estimation of genetic parameters and/or predicted breeding values in Turkey using new methodology (i.e. MTDFREML, GSAMP, PEST, …etc.).

The aims of this study are: (1) to estimate genetic (direct additive genetic variance and heritability) and non-genetic (common environmental effect) parameters, (2) to detect the bias in estimates of additive genetic variance when the common environmental effect is ignored or considered in the model, (3) to evaluate the performance of sires, dams and their progeny for productive traits in Broad Breasted Bronze through breeding values predicted of all birds, and (4) to estimate simple correlations among predictors.

MATERIAL AND METHODS

This work was carried out at Mehallet-Mousa Turkey Station, Animal Research Institute at Kafr El-Sheikh Governorate from January 1998 to August 1999. 30 sires and 85 dams of Broad Breasted Bronze (BBB) turkey were chosen randomly at sexual maturity from base population to be the parents for one generation. Dams were housed individually in metal cages during the egg production period. Each dam was provided with a feeder and a nipple drinker, while sires were divided randomly in floor pens (5m x 5m) with 15 sires housed in each. All chicks produced were wing banded pedigreed and transferred to the brooder houses. Water and fed were offered *ad libitum*. The starter ration (containing 27% crude protein and 2900 Kcal /Kg) was used during the period from hatch to 6 weeks. While in the growing period, growing ration (containing 22% crude protein and 2850 Kcal/Kg) was used during the period from 7-24 weeks.

System of mating

Artificial insemination was applied according to Lake and Stewart (1978) for getting semen from sires. Semen was collected individually once weekly from each sire to inseminate three definite dams per sire with a dose of 0.05 ml fresh diluted semen with normal saline (0.9% Na Cl). Semen was diluted with a ratio of 1:1.

Data

Data of individually live body weights (LBW) in grams for 444 males and 497 females were recorded at hatch, 4, 8, 12, 16, 20 and 24 weeks of age. Body measurements (BM) such as shank length (SL) and keel length (KL) in mm were measured at 16, 20 and 24 weeks. The symbols of the studied traits were described in Table 1. The data produced were analyzed using two models with new methodology, i.e. MTDFREML procedure (Boldman et al., 1995). The means, standard deviation (SD) and coefficient of variability for LBW and BM in males and females of BBB are given in Table 1.

Model of analysis:

Each trait was separately analysed using two single-trait animal models. The models in matrix notation were as follows:

Turkey, Growth traits, Heritability, Breeding values, Animal model.

$$y = Xb + Z_a u_a + e \qquad \text{(Model 1)}$$

$$y = Xb + Z_a u_a + Z_c u_c + e \qquad \text{(Model 2)}$$

Where y= nx1 vector of observed productive traits on bird; b= px1 vector of fixed effect of hatch (2 hatches), ua= qx1 vector of random effect of the bird; uc= vector of random common environment of dam family (85 levels); X, Za and Zc are the incidence matrices relating records to fixed effect of hatch, the additive genetic effect and random common environmental effect, respectively. e= nx1 vector of random residual effects.

The mixed model equations (MME) of the single-trait for two Animal Models described above were of the form:

$$\begin{bmatrix} X'X & X'Z_a \\ Z_a'X & Z_a'Z_a + A^{-1}\alpha_a \end{bmatrix} \begin{bmatrix} \hat{b} \\ \hat{u}_a \end{bmatrix} = \begin{bmatrix} X'y \\ Z_a'y \end{bmatrix} \qquad \text{(Model 1)}$$

$$\begin{bmatrix} X'X & X'Z_a & X'Z_c \\ Z_a'X & Z_a'Z_a + A^{-1}\alpha_a & Z_a'Z_c \\ Z_c'X & Z_c'Z_a & Z_c'Z_c + I_c\alpha_c \end{bmatrix} \begin{bmatrix} \hat{b} \\ \hat{u}_a \\ \hat{u}_c \end{bmatrix} = \begin{bmatrix} X'y \\ Z_a'y \\ Z_c'y \end{bmatrix} \qquad \text{(Model 2)}$$

Where A-1= inverse of the numerator relationship matrix among birds, αa= σ2e/σ2a and αc= σ2e/σ2c, Ic is identity matrix corresponding to levels of common environmental effect.

Estimates of variance components and heritability

Direct additive genetic variance and heritability were estimated using the two Animal Models. Common environmental variance was estimated using only Model 2. Variances obtained by the sire model (REML method using procedure VARCOMP, SAS, 1996) were used as starting values (guessed values) for the estimation of variance components using two single-trait Animal Models.

Heritability was computed as follows:

$$h_a^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2} \qquad \textbf{(}\text{Model 1}\textbf{)}$$

$$h_a^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_c^2 + \sigma_e^2} \qquad \textbf{(}\text{Model 2}\textbf{)}$$

Where σ_a^2, σ_c^2 and σ_e^2 are variances due to effects of direct additive genetic, common environment and random error, respectively.

Estimation of predicted breeding values

Predicted breeding values and their standard error and accuracy ($r_{A\hat{A}}$) were estimated using MTDFREML program (Boldman, et al., 1995).

RESULTS AND DISCUSSION

Direct additive genetic variance

Estimates of additive and non-additive genetic variance components for live body weight (LBW) and body measurements (BM) traits in males and females of BBB breed are given in Tables 2&3. When ignored the effect of common environmental effect (σ_c^2) in the model (Model 1), the percentages of additive genetic variance (σ_a^2) for LBW at early ages in males were lower (52% at hatch) than later age (75% at 24 week), while the reverse trend (62% for LBW0 and 56% for LBW20) was obtained in females (Table 3). Based on sire component, similar trend was recorded by Abplanalp and Kosin (1952) and Balat et al. (1993) with Broad Breasted Bronze and Mehallah 85 Turkey. On the other hand, percentages of σ_a^2 for BM traits in females were very low after 16 weeks of age. This may be due to high similarity between pullets for these traits. Generally, estimates of σ_a^2 for all studied traits in males were higher than those in females. The same result was reported by Johnson and Asmunson (1957), Krueger et al. (1972) and Havenstein et al. (1988) with different breeds of Turkey.

On the other hand, percentages of σ_a^2 for LBW traits in males were low when considered the effect of σ_c^2 in the animal model compared with those obtained when ignored that effect, while that percentages for LBW traits in females were nearly the same when ignored or considered the effect of σ_c^2 in the model. This indicated that the effects of σ_c^2 on LBW traits were large in males than in females (Tables 2 & 3).

Common environmental variance

The estimates of σ_c^2 included in the present study accounted for maternal permanent environmental variation, non-additive gene action, and sire-dam interaction that may present. The percentages of σ_c^2 were high for LBW at hatch and then decreased gradually as the males get older. The percentages of σ_c^2 were 39%, 27%, 15%, 3%, 5%, 0%, and 0% for LBW0, LBW4, LBW8, LBW12, LBW16, LBW20 and LBW24 in males, respectively (Table 2), while the percentages of σ_c^2 were zeros for all studied traits (except for LBW20, LBW24 and SL24 traits) in females. The higher percentages of σ_c^2 at early ages in males than in females may be due to the differences between the sex chromosomes of the males and females, i.e. sex-linked effect (Tone et al., 1984). Danbaro et al. (1995) reported that percentages of σ_c^2 were generally high (ranged from 9.64 to 38.36%) for LBW at 7 weeks in 5 lines of White Plymouth Rock chickens. Iraqi (1999) cited that percentages of σ_c^2 were ranged from 11.8 to 25.3% for LBW (during the period from hatch up to 16 weeks of age) in Dokki-4 chickens.

Bias in estimates of σ_a^2 for LBW and BM traits in males and females resulting when the effect of σ_c^2 ignored in the model are presented in Tables 2&3. These results showed that bias for LBW at hatch in males were very high (99.99%) and decreased thereafter as the tomes get older. This may be due to the high effect of σ_c^2 at early ages (39% at hatch). On the other hand, bias in estimates of σ_a^2 was low for LBW traits in females and BM traits in both sexes. Low estimates of bias for BM traits in males and females may be due to that the BM traits were measured at later ages, i.e. the non-additive genetic effects were very low. From these results, it was concluded that effect of σ_c^2 should be considered in the model to estimate direct additive genetic variance without any bias in early ages up to 12 weeks in males.

Heritability

Estimates of heritability (h_a^2) for LBW and BM traits in males and females of BBB using two animal models are presented in Tables 2&3. When ignored the effect of σ_c^2 in the model, estimates of h_a^2 were ranged from 0.52 to 0.75 for LBW traits, 0.0 to 0.46 for SL traits and 0.35 to 0.55 for KL traits in males. The corresponding values in females were 0.0 to 0.62, 0.0 to 0.24 and 0.0 to 0.42 for the same traits, respectively. These results indicated that estimates of h_a^2 for LBW and BM traits were higher in males than those in females. This could probably due to a very decidedly lower uncontrolled environmental variance component (σ_e^2) for males than females (Tables 2&3). Results in the present study are in agreement with reports of Abplanalp and Kosin (1952), Bumgardner and Shaffner (1954), Krueger et al. (1972) and Havenstein et al. (1988) based on sire component.

When considered the effect of σ_c^2 in the model, estimates of h_a^2 in males were reduced from 0.52 to 0.0, 0.70 to 0.53, 0.66 to 0.55, 0.70 to 0.68, 0.52 to 0.45 and 0.75 to 0.74 for LBW traits at hatch, 4, 8, 12, 16 and 24 weeks of age, respectively. This reduction might be due to the correction for the effect of σ_c^2 for LBW traits especially at early ages (39% at one day old) (Table 2), i.e. high bias in estimates of h_a^2 will be obtained if we ignored the effect of σ_c^2 in the model. Bumgardner and Shaffner (1954) found a large maternal effect on body weight particularly at the early ages. In general, estimates of h_a^2 for all studied traits in females and for BM traits in males were nearly the same when ignored or considered the effect of σ_c^2 in the model.

Predicted breeding values for birds with records (males and females)

The minimum, maximum and ranges of predicted breeding value (PBV) in males and females, their standard errors and accuracy for LBW and BM traits in BBB are given in Tables 4&5. When ignored the effect of σ_c^2 in the model, the ranges in PBV for males ranged from 13.80 to 4491.93 grams for LBW, 0.002 to 17.08 mm for SL traits, and 27.37 to 34.86 mm for KL traits, while the respective values in females ranged from 0.0 to 1812.13 grams, 0.002 to 31.12 mm, and 0.003 to 16.123 mm for the same traits. These results indicated that ranges in PBV for studied traits in males were wider than those in females.

When considering the effect of σ_c^2 in the model, the ranges in PBV were lower than those when ignoring it for most studied traits in males and females. The reductions of ranges in PBV when considered the effect of σ_c^2 in the model were 13.80, 117.828, 197.65, 69.33, 259.38, 13.39 and –2.74 in males; 0.047, 0.93, -2.254, 5.21, -2.38, 272.03 and –0.007 in females for LBW0, LBW4, LBW8, LBW12, LBW16, LBW20 and LBW24, respectively. These results showed that the ranges in PBV in females were not dramatically changed for LBW traits from hatch up to 16 weeks of age. This may be due to the effect of σ_c^2 on females were very small (equals to zeros) for that period (Table 3). Furthermore, the estimates of PBV when considering σ_c^2 in the model are more reliable (i.e. the predictors are BLUP associated with lower predicted error variance, Tables 2&3, and an increase in selection efficiency).

When ignored the effect of σ_c^2 in the model, the average of accuracy ($r_{A\hat{A}}$) across all minimum and maximum of PBV in males and females were 0.80 and 0.62; 0.44 and 0.21; and 0.66 and 0.25 for live body weight, shank length and keel length traits, respectively; while when considered the effect of σ_c^2 in the model, the corresponding values were 0.66 and 0.61; 0.43 and 0.22; and 0.63 and 0.25 for the same traits, respectively. These results indicated that $r_{A\hat{A}}$ of PBV for all studied traits in males was higher than those in females. This may be due to the high heritability estimates in males than females (Tables 2&3). Korhonen (1996) and Bourdon (1997) reported that estimates of $r_{A\hat{A}}$ for PBV dependent on heritability and available pedigree information on an individual. Estimates of $r_{A\hat{A}}$ in the present study are fall within the range of results' of Pribly and Pribylova (1991) and Iraqi (1999).

Predicted breeding values for sires (without records) of males and females

When ignoring or considering the effect of σ_c^2 in the model, the minimum and maximum estimates of breeding values predicted for sires of males (PBVSM) and females (PBVSF) and their ranges for LBW and BM traits (Table 6&7) indicate that estimates of PBVSM and PBVSF had the same trend obtained for PBV of males and females with records, respectively. The ranges in estimates of PBVSM were higher than those estimates of PBVSF (Table 6&7). However, the ranges in estimates of both PBVSM and PBVSF for most studied traits were low when considered the effect of σ_c^2 in the model than those estimates when ignored it.

The estimates of $r_{A\hat{A}}$ for the minimum and maximum of PBVSM and PBVSF had the same trend obtained for males and females with records, respectively. The estimates of $r_{A\hat{A}}$ of PBVSM were higher than those for PBVSF (Table 6&7). This may be due to high estimates of heritability in males than in females (Korhonen, 1996). Average of $r_{A\hat{A}}$ in the present study for PBVSM and PBVSF were low compared to estimates obtained by Iraqi (1999) in sires of progeny for Dokki-4 chickens.

Predicted breeding values for dams (without records) of males and females

When ignoring and considering the effect of σ_c^2 in the model, PBVDM and PBVDF and their ranges for LBW and BM traits (Tables 8&9) indicated that estimates for PBVDM and PBVDF had the same trend obtained for males and females with records, respectively. The same trend was obtained by Iraqi (1999) with Dokki-4 chickens. The ranges in estimates of PBVDM for most studied traits were higher than those estimates of PBVDF (Tables 8&9). Moreover, the ranges in estimates of PBVSM and PBVSF for most studied traits were higher than those for PBVDM and PBVDF. This due to large numbers of progeny per sire compared to per dam (the average number of progeny was 31 per sire vs 11 per dam). However, the ranges in estimates of both PBVDM and PBVDF for most studied traits were low when the effect of σ_c^2 was considered in the model than those estimates when ignored it.

The accuracy of minimum and maximum of PBVDM and PBVDF had the same trend obtained for males and females with records, respectively. When the effect of σ_c^2 ignored in the model, the $r_{A\hat{A}}$ across all the minimum and maximum of PBVDM were higher than those obtained for PBVDF. This may be due to high estimates of heritability in males than in females (Korhonen, 1996). Iraqi (1999) reported that average of $r_{A\hat{A}}$ across all minimum and maximum transmitting ability for dams of progeny (males and females) were 0.26 for body weight traits in Dokki-4 chickens.

Genetic correlation (r_G) between predicted breeding values

To determine the age of birds would be select for improving the body weights and measurements traits, the estimates of r_G were computed between breeding values predicted for all studied traits in males and females. The r_G between live body weights in males and females of BBB (Table 10&11) were positive and significantly when ignoring or considering the effect of σ_c^2 in the model. The values ranged from low (especially between LBW0 and other studied traits) to high but in general being high. There was also a decline with age in the genetic correlations between these traits.

Body weight at 4 weeks was closely correlated and high values of r_G with most other LBW traits in males (Table 10). Therefore, we can select the males of BBB as to be parent for the next generation based on breeding values predicted at 4 weeks of age to improve the growth traits, i.e. the cost of breeding program is reduced. While, the genetic correlations between LBW at 8 weeks of age (Table 11) and body weights and measurements were moderate or high and significantly positive in females. Thus, we can select the females at 8 weeks to improve the productive traits in BBB.

Estimates of r_G between most of studied traits were nearly the same in females when considering or ignoring the effect of σ_c^2 in the model. But, that estimates in males were greatly declined, when considering the effect of σ_c^2 in the model, between LBW0 and other studied traits. This may be due to bias in estimates of breeding values predicted when ignoring the effect of σ_c^2 in the model. All estimates of r_G in the present study are fall within the range based on sire component obtained by McCarteny (1961), Johnson and Asmundson (1957) and Krueger et al. (1972).

CONCLUSION

1. Common environmental effect should be considered in the model in the early ages to obtained direct additive genetic variance without any bias. Thus, the estimates of PBV are more reliable, i.e. the predictors are BLUP associated with lower predicted error variance.
2. High and positive genetic correlations among predictors lead to conclude that males could be selected based on breeding values predicted at 4 weeks, while females could be selected at 8 weeks as to be parents for the next generation to improve the productive traits of BBB, i.e. the cost of breeding program is reduced.

Table 1. Means, phenotypic standard deviation and coefficient of variability for body weights and body measurements in males and females of Broad Breast Bronze

Trait	Symbols	Males				Females			
		No.	Mean	SD	CV	No.	Mean	SD	CV
Body weights (gm):									
Body weight at hatch	**BW0**	444	55.40	4.83	8.72	497	54.28	5.02	9.25
Body weight at 4 weeks	**BW4**	444	493.02	130.1	26.39	497	411.80	99.66	24.20
Body weight at 8 weeks	**BW8**	444	1414.53	344.57	24.36	497	1098.54	277.96	25.30
Body weight at 12 weeks	**BW12**	444	2936.37	635.13	21.63	497	2074.85	497.40	23.97
Body weight at 16 weeks	**BW16**	444	4599.77	729.61	15.86	497	3130.38	594.0	18.98
Body weight at 20 weeks	**BW20**	417	5779.86	792.39	13.71	456	3756.14	523.60	13.94
Body weight at 24 weeks	**BW24**	399	7146.12	1064.7	14.90	442	4229.64	514.73	12.17
Body measurements (mm):									
Shank Length at 16 weeks	**SL16**	444	145.6	7.8	5.37	497	115.7	7.53	6.51
Shank Length at 20 weeks	**SL20**	417	149.6	5.6	3.74	456	117.5	5.72	4.87
Shank Length at 24 weeks	**SL24**	399	152.6	5.0	3.30	442	119.1	5.23	4.39
Keel Length at 16 weeks	**KL16**	444	155.9	10.8	6.90	497	132.6	11.19	8.44
Keel Length at 20 weeks	**KL20**	417	175.6	10.0	5.69	456	144.5	9.08	6.29
Keel Length at 24 weeks	**KL24**	399	191.9	10.9	5.68	442	152.3	8.20	5.38

Table 2: Estimates of variance components and their percentages for productive traits of males in Broad Breasted Bronze.

Trait	Model 1*						Model 2**										
	σ_a^2	%	σ_e^2	%	σ_p^2	h_a^2	σ_a^2	%	σ_c^2	%	σ_e^2	%	σ_p^2	h_a^2	Bias+	%
Body weights:																
BW0	12.13	52	11.4	48	23.5	0.52	0.001	00	9.495	39	14.555	61	24.05	0.00	12.13	99.99
BW4	8708.57	70	3664.4	30	12373.0	0.70	7730.321	53	3900.25	27	2901.519	20	14532.095	0.53	978.25	11.23
BW8	66074.94	66	34393.5	34	100468.5	0.66	58594.77	55	15706.8	15	33049.83	31	107351.44	0.55	7480.17	11.32
BW12	246530.08	70	104411.7	30	352064.8	0.70	245342.53	68	12334.1	3	101072.02	28	358748.66	0.68	1187.55	0.48
BW16	268480.73	52	252650.1	48	521130.8	0.52	236000.86	45	24798.3	5	262626.74	50	523425.95	0.45	32479.87	12.1
BW20	401147.37	70	172565.5	30	573712.9	0.70	399231.35	70	0.05	00	173853.16	30	373084.55	0.70	1916.02	0.48
BW24	708578.39	75	242405.3	25	950983.3	0.75	707477.99	74	0.084	00	243502.8	26	950980.9	0.74	1100.4	0.16
Body measurements:																
SL16	22.32	36	39.37	64	61.69	0.36	22.092	36	0.014	00	39.618	64	61.724	0.36	0.23	1.02
SL20	14.65	46	16.86	54	31.52	0.46	12.801	41	0.0801	2	17.799	57	31.402	0.41	1.85	0.13
SL24	0.0011	00	25.296	100	25.2297	0.00	0.0011	00	0.0012	00	25.338	100	25.340	0.00	00	00
KL16	40.61	35	74.30	65	114.912	0.35	29.494	26	7.500	6	78.115	68	115.11	0.26	11.12	27.37
KL20	50.03	54	42.24	46	92.261	0.54	49.758	54	0.008	00	42.169	46	91.935	0.54	0.27	0.54
KL24	59.22	55	48.88	45	108.102	0.55	59.181	55	0.005	00	48.983	45	108.169	0.55	0.04	0.07

Traits as defined in Table 1.

* Model 1= Hatch + additive genetic effect of bird + error

** Model 2= Hatch + additive genetic effect of bird + common environmental effect + error

+Bias= σ_a^2 (Model 1) - σ_a^2 (Model 2).

Table 3: Estimates of variance components and their percentages for productive traits of females in Broad Breasted Bronze.

Trait	Model 1*	Model 2**

	σ^2_a	%	σ^2_e	%	σ^2_p	h^2_a	σ^2_a	%	σ^2_c	%	σ^2_e	%	σ^2_p	h^2_a	Bias[+]	%
Body weights:																
BW0	15.19	62	9.22	38	24.41	0.62	15.207	62	0.0092	0	9.297	38	24.514	0.62	-0.017	-0.112
BW4	4835.06	61	3091.93	39	7926.99	0.61	4832.96	61	13.657	0	3090.96	39	7937.58	0.61	2.1	0.0434
BW8	38214.4	56	30535.3	44	68748.74	0.56	38487.701	56	0.00132	0	30517.998	44	69005.7	0.56	-273.301	-0.715
BW12	132111.8	61	85393.94	39	217505.76	0.61	130822.32	60	0.0117	0	85620.202	40	216442.53	0.60	1289.49	0.9761
BW16	160338.9	47	181586.89	53	341925.76	0.47	160546.63	47	0.0135	0	181187.03	53	341733.67	0.47	-207.76	-0.13
BW20	148718	56	116625.58	44	265343.6	0.56	126522.43	48	13995.9	5	125158.82	47	265677.11	0.48	22195.59	14.925
BW24	0.0332	0	265206.31	100	265206.34	0.00	0.0721	0	72784.9	27	194760.26	73	267545.62	0.00	-0.0389	-117.2
Body measurements:																
SL16	13.57	24	42.67	76	56.24	0.24	13.925	25	0.602	0	42.083	75	56.01	0.25	-0.355	-2.616
SL20	0.0012	0	32.605	100	32.61	0.00	0.0011	0	0.0013	0	32.612	100	32.615	0.00	0.0001	8.3333
SL24	0.0011	0	27.292	100	27.29	0.00	0.00515	0	3.781	14	23.502	86	27.289	0.00	-0.00405	-368.2
KL16	51.932	42	71.618	58	123.55	0.42	51.805	42	0.0116	0	71.922	58	123.738	0.42	0.127	0.2446
KL20	0.0011	0	82.422	100	82.423	0.00	0.0011	0	0.0013	0	82.462	100	82.464	0.00	0	0
KL24	0.00112	0	67.18	100	67.181	0.00	0.00012	0	0.0379	0	66.689	100	66.727	0.00	0.001	89.286

Traits and Models as defined in Tables 1 and 2, respectively.

[+]Bias= σ^2_a (Model 1) - σ^2_a (Model 2).

Table 4. Minimum, maximum and ranges of predicted breeding values for males (**PBVM**) with records, their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in Broad Breasted Bronze.

Trait	Model 1							Model 2						
	Minimum			Maximum			Range in PBVM	Minimum			Maximum			Range in PBVM
	PBVM	SE	$r_{A\hat{A}}$	PBVM	SE	$r_{A\hat{A}}$		PBVM	SE	$r_{A\hat{A}}$	PBVM	SE	$r_{A\hat{A}}$	
Body weights:														
BW0	-6.735	1.80	0.73	7.065	2.38	0.86	13.80	-0.001	0.03	0.01	0.001	0.03	0.01	0.002
BW4	-189.195	36.78	0.84	279.546	50.17	0.92	468.741	-139.275	42.73	0.73	211.638	59.61	0.87	350.913
BW8	-462.711	109.53	0.82	773.39	148.37	0.90	1236.10	-387.517	123.2	0.75	650.931	160.99	0.86	1038.45
BW12	-1290.64	196.27	0.84	1187.55	267.70	0.92	2478.19	-1261.55	210.4	0.82	1147.31	280.23	0.90	2408.86
BW16	-936.164	268.48	0.73	1246.33	354.68	0.85	2182.49	-831.012	279.2	0.68	1092.10	354.40	0.82	1923.11
BW20	-1400.06	251.69	0.46	1656.04	561.81	0.92	3056.10	-1392.75	252.3	0.46	1649.96	559.63	0.92	3042.71
BW24	-2298.25	306.41	0.47	2193.69	741.84	0.93	4491.93	-2300.04	306.2	0.47	2194.64	742.45	0.93	4494.67
Body measurements:														
SL16	-11.217	2.91	0.62	5.862	0.79	0.79	17.079	-11.116	2.91	0.62	5.831	3.70	0.79	16.947
SL20	-11.046	2.11	0.40	6.03	0.83	0.83	17.076	-9.821	2.13	0.38	5.481	3.32	0.80	15.302
SL24	-0.001	0.03	0.0	.001	0.03	0.01	0.002	-0.001	0.03	0.0	0.001	0.03	0.01	0.002
KL16	-14.876	3.96	0.61	12.493	5.04	0.78	27.369	-10.954	3.88	0.52	9.07	4.62	0.70	20.024
KL20	-16.833	3.55	0.42	16.525	6.42	0.87	33.358	-16.819	3.55	0.42	16.515	6.41	0.87	33.334
KL24	-15.981	3.83	0.42	18.882	6.98	0.87	34.863	-15.965	3.83	0.42	18.865	6.97	0.87	34.830

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of progeny with records evaluated were 552.

Table 5. Minimum, maximum and ranges of predicted breeding values for females (**PBVF**) with records, their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in Broad Breasted Bronze.

Trait	**Model 1**							**Model 2**						
	Minimum			**Maximum**			**Range in PBVF**	**Minimum**			**Maximum**			**Range in PBVF**
	PBVF	**SE**	$r_{A\hat{A}}$	**PBVF**	**SE**	$r_{A\hat{A}}$		**PBVF**	**SE**	$r_{A\hat{A}}$	**PBVF**	**SE**	$r_{A\hat{A}}$	
<u>Body weights:</u>														
BW0	-9.046	1.74	0.62	7.861	3.05	0.89	16.907	-9.024	1.75	0.62	7.836	3.05	0.89	16.86
BW4	-134.772	31.66	0.62	268.236	54.62	0.89	403.01	-134.341	31.75	0.62	267.739	54.69	0.89	402.08
BW8	-342.289	95.67	0.60	591.598	156.48	0.87	933.89	-343.276	95.78	0.60	592.868	156.93	0.87	936.144
BW12	-786.411	166.08	0.62	883.232	285.76	0.89	1669.64	-782.999	165.9	0.62	881.43	284.65	0.89	1664.43
BW16	-969.604	217.42	0.56	679.39	330.62	0.84	1648.99	-970.952	217.3	0.56	680.421	330.73	0.84	1651.37
BW20	-920.51	188.12	0.33	891.62	364.01	0.87	1812.13	-791.113	198.6	0.31	748.984	338.51	0.83	1540.10
BW24	0.0	0.180	0.0	0.0	0.180	0.0	0.0	-0.003	0.72	0.0	0.004	0.72	0.0	0.007
<u>Body measurements:</u>														
SL16	-10.249	2.55	0.53	5.878	3.12	0.72	16.127	-10.487	2.57	0.54	5.972	3.15	0.73	16.459
SL20	-0.001	0.03	0.0	0.002	0.03	0.01	0.003	-0.001	0.03	0.0	0.002	0.03	0.01	0.003
SL24	-0.004	0.03	0.0	0.002	0.002	0.01	0.003	-0.004	0.07	0.01	0.004	0.07	0.03	0.008
KL16	-18.12	4.13	0.67	13.002	5.33	0.82	31.122	-18.064	4.13	0.67	12.972	5.33	0.82	31.036
KL20	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.001	0.03	0.0	0.001	0.03	0.01	0.002
KL24	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	0.0	0.01	0.0	0.0	0.01	0.0	0.0

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of progeny with records evaluated were 604.

Table 6. Minimum, maximum and ranges of predicted breeding values for sires of males (**PBVSM**) (sires without records), their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in Broad Breasted Bronze.

Trait	Model 1							Model 2						
	Minimum			Maximum			Range in PBVSM	Minimum			Maximum			Range in PBVSM
	PBVSM	SE	$r_{A\hat{A}}$	PBVSM	SE	$r_{A\hat{A}}$		PBVSM	SE	$r_{A\hat{A}}$	PBVSM	SE	$r_{A\hat{A}}$	
Body weights:														
BW0	-3.759	2.11	0.57	5.536	2.85	0.80	9.285	0.0	0.01	0.01	0.001	0.03	0.01	0.001
BW4	-149.55	53.58	0.63	238.90	72.38	0.82	388.45	-110.68	60.51	0.53	164.46	74.33	0.72	275.14
BW8	-372.14	149.2	0.62	641.94	201.93	0.81	1014.08	-307.92	160.2	0.55	511.59	201.4	0.75	819.51
BW12	-658.66	285.7	0.63	982.37	386.01	0.82	1641.03	-614.91	298.7	0.61	915.72	390.0	0.79	1530.63
BW16	-572.63	313.1	0.57	902.04	423.50	0.80	1474.67	-505.683	314.8	0.54	781.98	409.5	0.76	1287.66
BW20	-861.58	365.2	0.63	1367.48	491.85	0.82	2229.06	-859.08	364.0	0.63	1364.51	490.2	0.82	2223.59
BW24	-1226.38	480.3	0.64	1949.10	645.61	0.82	3175.48	-1226.60	480.6	0.64	1949.51	646.1	0.82	3176.11
Body measurements:														
SL16	-5.076	3.05	0.51	5.834	4.07	0.76	10.91	-5.049	3.04	0.51	5.816	4.05	0.76	10.865
SL20	-4.899	2.37	0.55	5.633	3.18	0.78	10.53	-4.567	2.34	0.52	5.207	3.05	0.76	9.774
SL24	-.001	0.03	0.01	0.001	0.03	0.02	0.002	-0.001	0.03	0.01	0.001	0.03	0.02	0.002
KL16	-7.955	4.14	0.50	10.255	5.50	0.76	18.21	-6.003	3.95	0.43	7.737	4.90	0.69	13.740
KL20	-10.44	4.26	0.58	14.512	5.75	0.80	24.95	-10.437	4.26	0.58	14.506	5.74	0.80	24.943
KL24	-13.956	4.63	0.58	15.674	6.24	0.80	29.63	-13.95	4.63	0.58	15.666	6.24	0.80	29.616

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of sires without records evaluated were 30.

Table 7. Minimum, maximum and ranges of predicted breeding values for sires of females (**PBVSF**) (sires without records), their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in Broad Breasted Bronze.

Trait	**Model 1**							**Model 2**						
	Minimum			**Maximum**			**Range in PBVSF**	**Minimum**			**Maximum**			**Range in PBVSF**
	PBVSF	**SE**	$r_{A\hat{A}}$	**PBVSF**	**SE**	$r_{A\hat{A}}$		**PBVSF**	**SE**	$r_{A\hat{A}}$	**PBVSF**	**SE**	$r_{A\hat{A}}$	
Body weights:														
BW0	-7.913	2.23	0.69	4.778	2.80	0.82	12.691	-7.901	2.23	0.69	4.77	2.81	0.82	12.671
BW4	-77.920	39.90	0.69	181.558	50.18	0.82	259.478	-77.702	39.99	0.69	181.086	50.23	0.82	258.788
BW8	-282.11	113.80	0.68	438.748	143.48	0.81	720.858	-282.473	114.14	0.68	439.46	143.90	0.81	721.933
BW12	-514.991	208.69	0.69	786.574	262.51	0.82	1301.57	-514.198	207.82	0.69	785.603	261.46	0.82	1299.80
BW16	-644.165	239.62	0.65	677.055	302.83	0.80	1321.22	-644.49	239.70	0.65	677.438	302.93	0.80	1321.93
BW20	-637.436	226.37	0.65	680.047	293.76	0.81	1317.48	-555.981	228.71	0.61	609.297	282.31	0.77	1165.28
BW24	0.0	0.18	0.0	0.001	0.180	0.0	0.001	-0.002	0.72	0.0	0.004	0.72	0.0	0.006
Body measurements:														
SL16	-6.441	2.48	0.54	4.633	3.10	0.74	11.074	-6.53	2.50	0.55	4.683	3.13	0.74	11.213
SL20	-0.001	0.03	0.01	0.002	0.03	0.02	0.003	-0.001	0.03	0.01	0.001	0.03	0.02	0.002
SL24	-0.001	0.03	0.01	0.002	0.03	0.02	0.003	-0.003	0.07	0.01	0.004	0.07	0.02	0.007
KL16	-10.955	4.39	0.64	12.60	5.55	0.79	23.555	-10.938	4.39	0.64	12.572	5.55	0.79	23.510
KL20	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.001	0.03	0.0	0.001	0.03	0.01	0.002
KL24	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	0.0	0.01	0.0	0.0	0.01	0.0	0.0

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of sires without records evaluated were 30.

Table 8. Minimum, maximum and ranges of predicted breeding values for dams of males (**PBVDM**) (dams without records), their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in Broad Breasted Bronze.

Trait	Model 1							Model 2						
	Minimum			Maximum			Range in PBVDM	Minimum			Maximum			Range in PBVDM
	PBVDM	SE	$r_{A\hat{A}}$	PBVDM	SE	$r_{A\hat{A}}$		PBVDM	SE	$r_{A\hat{A}}$	PBVDM	SE	$r_{A\hat{A}}$	
Body weights:														
BW0	-6.786	2.48	0.37	7.865	3.24	0.70	14.651	0.0	0.03	0.0	0.0	0.03	0.01	0.0
BW4	-147.221	62.0	0.43	161.546	84.19	0.75	308.767	-79.531	70.72	0.37	82.414	81.45	0.59	161.945
BW8	-387.342	173.52	0.42	452.947	233.78	0.74	840.289	-263.829	190.9	0.38	316.891	224.39	0.61	580.72
BW12	-735.98	330.69	0.43	807.142	448.99	0.75	1543.12	-639.794	357.4	0.42	675.320	447.12	0.69	1315.11
BW16	-668.84	368.36	0.36	731.367	481.17	0.70	1400.21	-538.264	377.5	0.34	611.855	456.87	0.63	1150.12
BW20	-1048.63	426.46	0.43	990.585	571.86	0.74	2039.22	-1046.11	425.1	0.43	987.721	569.72	0.74	2033.83
BW24	-1062.14	561.35	0.45	1385.37	753.80	0.75	2447.51	-1062.50	561.7	0.45	1385.92	754.40	0.75	2448.42
Body measurements:														
SL16	-7.555	3.61	0.30	6.304	4.50	0.65	13.859	-7.494	3.59	0.30	6.256	4.48	0.64	13.750
SL20	-6.263	2.80	0.34	5.852	3.58	0.68	12.115	-5.407	2.79	0.32	4.969	3.39	0.63	10.376
SL24	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.001	0.03	0.0	0.001	0.03	0.01	0.002
KL16	-7.747	4.88	0.30	8.376	6.08	0.64	16.123	-5.236	4.62	0.25	5.842	5.25	0.52	11.078
KL20	-9.813	5.04	0.37	9.715	6.56	0.70	19.528	-9.805	5.03	0.37	9.707	6.55	0.70	19.512
KL24	-11.67	5.52	0.38	11.908	7.13	0.70	23.578	-11.656	5.52	0.38	11.896	7.13	0.70	23.552

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of dams without records evaluated were 85.

Table 9. Minimum, maximum and ranges of predicted breeding values for dams of females (**PBVDF**) (dams without records), their standard errors (**SE**) and accuracy of prediction ($r_{A\hat{A}}$) estimated by uni-trait animal model for productive traits in.

Trait	Model 1							Model 2						
	Minimum			Maximum			Range in PBVDF	Minimum			Maximum			Range in PBVDF
	PBVDF	SE	$r_{A\hat{A}}$	PBVDF	SE	$r_{A\hat{A}}$		PBVDF	SE	$r_{A\hat{A}}$	PBVDF	SE	$r_{A\hat{A}}$	
Body weights:														
BW0	-9.885	2.60	0.41	3.560	3.56	0.75	17.367	-9.827	2.60	0.41	7.491	3.56	0.74	17.318
BW4	-86.478	46.55	0.40	128.40	63.59	0.74	214.878	-85.917	46.75	0.40	126.888	63.58	0.74	221.805
BW8	-192.948	133.62	0.38	333.107	180.45	0.73	526.055	-193.31	134.0	0.39	333.497	181.04	0.73	526.807
BW12	-468.476	243.57	0.40	615.626	332.52	0.74	1084.10	-467.24	242.6	0.40	614.671	331.07	0.74	1081.91
BW16	-495.045	283.87	0.35	597.979	374.99	0.71	1093.02	-495.479	283.9	0.35	598.904	375.18	0.71	1094.38
BW20	-525.279	266.75	0.0	653.45	385.64	0.72	1178.73	-437.05	273.4	0.0	524.183	355.70	0.64	961.233
BW24	0.0	0.18	0.0	0.0	0.18	0.0	0.0	-0.002	0.720	0.0	0.002	0.72	0.0	0.004
Body measurements:														
SL16	-5.07	2.95	0.25	4.439	3.57	0.60	9.509	-5.162	2.97	0.25	4.499	3.61	0.001	9.661
SL20	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.001	0.03	0.0	0.001	0.03	0.01	0.002
SL24	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.002	0.07	0.02	0.002	0.07	0.02	0.004
KL16	-8.985	5.22	0.33	9.428	6.80	0.69	18.413	-8.956	5.22	0.33	9.408	6.79	0.69	18.364
KL20	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	-0.001	0.0	0.0	0.001	0.03	0.01	0.002
KL24	-0.001	0.03	0.0	0.001	0.03	0.01	0.002	0.0	0.01	0.0	0.0	0.01	0.0	0.0

Traits and Models as defined in Tables 1 and 2, respectively.
Total numbers of dams without records evaluated were 85.

Table 10. Estimates of genetic correlations between productive traits using single-trait animal model when ignored (above diagonal) and considered (blow diagonal) the effects of common environmental for males in BBB.

Traits correlated[+]	BW0	BW4	BW8	BW12	BW16	BW20	BW24	SL16	SL20	SL24	KL16	KL20	KL24
BW0		0.21**	0.15**	0.10**	0.22**	0.27**	0.22**	0.18**	0.30**	0.27**	0.15**	0.24**	0.25**
BW4	0.03ns		0.89**	0.77**	0.73**	0.73**	0.74**	0.75**	0.51**	0.40**	0.18**	0.68**	0.71**

BW8	0.02ns	0.87**		0.84**	0.73**	0.71**	0.72**	0.48**	0.37**	0.17**	0.60**	0.61**	0.63**
BW12	0.04ns	0.73**	0.82**		0.83**	0.73**	0.73**	0.57**	0.43**	0.13**	0.65**	0.58**	0.61**
BW16	0.01ns	0.69**	0.71**	0.83**		0.90**	0.83**	0.71**	0.56**	0.22**	0.75**	0.68**	0.66**
BW20	0.002ns	0.69**	0.68**	0.72**	0.90**		0.92**	0.64**	0.57**	0.30**	0.64**	0.69**	0.69**
BW24	0.01ns	0.69**	0.69**	0.72**	0.83**	0.92**		0.59**	0.51**	0.34**	0.64**	0.70**	0.73**
SL16	0.002ns	0.45**	0.44**	0.57**	0.71**	0.64**	0.59**		0.86**	0.44**	0.68**	0.61**	0.58**
SL20	0.04ns	0.35**	0.35**	0.43**	0.57**	0.57**	0.52**	0.86**		0.65**	0.50**	0.53**	0.56**
SL24	0.05ns	0.14**	0.14**	0.11**	0.22**	0.30**	0.33**	0.45**	0.67**		0.13**	0.25**	0.34**
KL16	-0.02ns	0.65**	0.59**	0.67**	0.76**	0.65**	0.65**	0.69**	0.51**	0.13**		0.89**	0.80**
KL20	0.02ns	0.67**	0.58**	0.57**	0.68**	0.69**	0.70**	0.61**	0.53**	0.24**	0.89**		0.93**
KL24	0.06ns	0.65**	0.61**	0.60**	0.66	0.69**	0.73**	0.58**	0.56**	0.33**	0.80**	0.93**	

+Traits as defined in Table 20.
ns= non-significant; *= P<0.05 and **= P<0.01.

Table 11. Estimates of genetic correlations between productive traits using single-trait animal model when ignored (above diagonal) and considered (blow diagonal) the effects of common environmental for females in BBB.

Traits correlated+	BW0	BW4	BW8	BW12	BW16	BW20	BW24	SL16	SL20	SL24	KL16	KL20	KL24
BW0		0.26**	0.19**	0.16**	0.21**	0.30**	0.01ns	0.23**	0.25**	0.20**	0.23**	0.29**	0.23**
BW4	0.25**		0.88**	0.76**	0.60**	0.60**	0.09*	0.35**	0.30**	0.16**	0.60**	0.55**	0.43**
BW8	0.19**	0.88**		0.86**	0.65**	0.60**	0.09*	0.42**	0.30**	0.14**	0.66**	0.49**	0.41**
BW12	0.16**	0.76**	0.86**		0.85**	0.77**	0.10**	0.54**	0.36**	0.21**	0.80**	0.54**	0.42**
BW16	0.21**	0.60**	0.65**	0.85**		0.91**	0.10*	0.67**	0.43**	0.31**	0.84**	0.48**	0.34**
BW20	0.29**	0.61**	0.61**	0.78**	0.91**		0.09*	0.64**	0.49**	0.38**	0.81**	0.56**	0.48**
BW24	0.28**	0.56**	0.53**	0.63**	0.71**	0.84*		0.05ns	0.07ns	0.06ns	0.05	0.08*	0.08*
SL16	0.23**	0.35**	0.42**	0.54**	0.67**	0.65**	0.56**		0.75**	0.69**	0.63**	0.29**	0.36**
SL20	0.27**	0.31**	0.32**	0.37**	0.42**	0.49**	0.51**	0.72**		0.19**	0.40**	0.28**	0.36**
SL24	0.20**	0.19**	0.18**	0.27**	0.43**	0.51**	0.53**	0.75**	0.23**		0.28**	0.19**	0.32**
KL16	0.23**	0.60**	0.66**	0.80**	0.84**	0.81**	0.62**	0.63**	0.39**	0.39**		0.64**	0.55**
KL20	0.29**	0.57**	0.51**	0.56**	0.48**	0.57**	0.57**	0.30**	0.32**	0.23**	0.63**		0.70**
KL24	0.32**	0.53**	0.53**	0.59**	0.60**	0.74**	0.73**	0.55**	0.47**	0.49**	0.77**	0.70**	

+Traits as defined in Table 20.
*= $P<0.05$ and **= $P<0.01$.

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Turkey, Growth traits, Heritability, Breeding values, Animal model.

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الملخص العربى

تقدير المعايير الوراثية عند أخذ أو اهمال التأثير البيئى العام فى نموذج الحيوان الوراثى للصفات الانتاجية فى الرومى البرونزى عريض الصدر

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تم التنبؤ بالمعايير الوراثية باستخدام نموذج الحيوان الوراثى للصفة الواحدة عند أخذ أو اهمال التأثير البيئى العام حيث استخدم 444 ذكر و 497 انثى من الرومى البرونزى عريض الصدر. وقد درست صفات وزن الجسم الحى من عمر الفقس – 24 اسبوع ، وصفات طول الساق وطول عظمة القص عند عمر 16 ، 20 ، 24 أسبوع. وقد أظهرت النتائج مايلى:

1. كانت نسب التباين الوراثى التجمعى لصفات وزن الجسم الحى منخفضة فى الأعمار المبكرة (52% عند عمر الفقس) عن الأعمار المتأخرة (75% عند عمر 24 أسبوع) فى الذكور ، بينما أخذت تلك النسب اتجاه عكسى فى الاناث (62% ، 56% لصفة وزن الجسم عند عمر الفقس وعمر 20 أسبوع على التوالى) وذلك عند اهمال التأثير البيئى العام فى نموذج الحيوان. وكانت نسب التباين التجمعى لصفات وزن الجسم الحى منخفضة عند أخذ التأثير البيئى العام فى نموذج الحيوان بالمقارنة بتلك المتحصل عليها عند اهمال ذلك التأثير.
2. كانت نسب التباين البيئى العام مرتفعة لصفات وزن الجسم الحى عند عمر الفقس (39%) ثم انخفضت تدريجيا كلما تقدمت الذكور فى العمر ، بينما كانت تلك النسب تساوى صفر% لمعظم الصفات المدروسة فى الاناث.
3. كان التحيز فى تقدير التباين الوراثى التجمعى عند أخذ التأثير البيئى العام فى نموذج الحيوان مرتفع جدا (99.99%) لوزن الجسم الحى عند عمر الفقس فى الذكور ، ثم انخفض بعد ذلك كلما تقدمت الذكور فى العمر ليصل الى 0.16% لصفة وزن الجسم الحى عند عمر 24 أسبوع.

Turkey, Growth traits, Heritability, Breeding values, Animal model.

4. كانت قيم المكافئى الوراثى المقدرة للذكور مرتفعة لكل الصفات المدروسة بالمقارنة بتلك المقدرة للاناث وذلك عند أخذ التأثير البيئى العام فى نموذج الحيوان.
5. تراوح المدى للقيم التربوية المتنبأ بها من 13.80 –449.93 جرام لصفات وزن ، 0.002– 17.08 ملليمتر لصفات طول الساق ، 27.37– 34.86 ملليمتر لصفات طول عظمة القص فى الذكور ، بينما تراوحت القيم المناظرة فى الاناث لنفس الصفات على الترتيب 0–1812.13 جرام ، 0.002–31.12 ملليمتر ، 0.003–16.12 ملليمتر عند اهمال التأثير البيئى العام فى نموذج الحيوان.
6. عند اهمال التأثير البيئى العام فى نموذج الحيوان فان متوسط معاملات الدقة لكلا من الحد الأدنى والحد الأعلى للقيم التربوية لكل الصفات المدروسة أعلى فى نسل الذكور عن نسل الاناث.
7. تراوحت قيم الارتباطات الوراثية البسيطة بين القيم التربوية المتنبأ بها من منخفضة الى مرتفعة (ولكن كانت غالبا مرتفعة) ، كما كانت موجبة ومعنوية لمعظم صفات النمو فى الذكور والاناث البرونزى عريض الصدر.