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EFFECT OF EARLY SELECTION FOR BODY WEIGHT, KEEL LENGTH AND BREAST CIRCUMFERENCE ON EGG PRODUCTION TRAITS IN INSHAS STRAIN OF CHICKENS

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ABSTRACT*:* Inshas strain of chicken was subjected to one cycle of early selection for body weight, keel length and breast circumference effect on egg production traits. Best linear unbiased prediction (BLUP) was used for predicting the breeding values and ranking then selecting hens. The selection differentials in G1 were equal to 2.6, 16.7, 72.4, 58.7 g, 0.1, -0.1, 0.6 cm, -9.0 g, 12.0 d, -16.0 egg, 0.6 g, -668 g, -17.0 egg, 1.9 g and -731 g for body weight at hatch (BWH), body weight at 4 weeks of age (BW4), body weight at 8 weeks of age (BW8), body weight at 12 weeks of age (BW12), Shank length (SL), Keel length (KL), Breast circumference (Br), body weight at sexual maturity (BWSM), age at sexual maturity (ASM), egg number at 90 d of production (EN1), egg weight at 90 d of production (EW1), egg mass at 90 d of production (EM1),), egg number at150 d of production (EN2), egg weight at 150 d of production (EW2), egg mass at 150 d of production (EM2), respectively. These values in stander units were equal to 0.9, 0.3, 0.5, 0.4, 0.01, -0.2, 0.3, -0.06, 0.77, -3.5, 0.15, -3.7, -1.5, 0.5 and -1.3, respectively. The realized genetic gain exceeded the expected genetic gain for BWH, BW4, BW8, BW12, SL, Br, ASM and EW2 2.4, 13.7, 51.9, 39.9, 0.3, 1.4, 5.4, 0.7 vs. 2.0, 3.9, 19.0, 11.0, 0.1, 1.0, 1.9 and 0.1. From the results of the present study, selection was effective in improving body weight traits by the generation (G1) of study. The heritability estimates in this study were moderate to high for most of the traits studied. This is an encouraging factor for more intense selection within the Inshas local chicken population.

Key Words: Local chicken- BLUP- breeding values and responses of selection.

INTRODUCTION

The principal objective of selective breeding is genetic improvement of economically important traits in successive generations. Improving these economical traits, such production efficiency would save these genetic resources. Local chickens are important in producing a large and cheap source of animal protein in Egypt, beside pure Egyptian breeds there were some local developed strains that established for both meat and egg production. Inshas strain which was developed by crossing between Sinai and White Plymouth Rock breeds (Baker et al., 2002). It is will recognized that the mean and genetic variance will change as a result of selection. Eisen *et al.* (1973) reported that the smaller effective population sizes tend to decrease selection response and realized heritability, through reducing the selection intensities per generation. The study of the genetic parameters of the different economic traits, such as, egg number, egg weight, egg mass, age at sexual maturity and body weight at sexual maturity should be suggested in breeding plan. Egg production depends on many characters such as age at sexual maturity, egg number, egg weight, body weight, egg quality. Selection differentials and realized heritability for egg production traits were reported by Soltan (1991) in Sinai fowl and El-Wardany and Abdou (1993) in Norfa strain, Younis and Abd El-Ghany (2004) in Silver Montazah and Saleh et al., (2006) in Inshas strain. Genetic parameters heritability and genetic correlation of egg production traits in different breeds and/or strains were cited by many investigators, who found that there were a lot of variations in these estimates according to the differences of the genetic make-up (Khalil et al., 2004; Nurgiartiningsih et al., 2004). The heritabilities for monthly egg production were estimated between 0.04 to 0.44 Nurgiartiningsih et al, (2004). The direct heritabilities estimated for body weight at 4, 8, 12 and 16 weeks of age for a Maxican Chicken by Prado Gonzalez et al, (2003) were between 0.07 to 0.21. The reported heritabilities by Mohamed Abadi (1999) were 0.39, 0.36, 0.19, 0.32, 0.40 and 0.41 for body weight at 12 weeks, age at sexual maturity, egg number and egg weight at 28, 30 and 32 weeks, respectively. Also Zieba and Lukaszewicz (2003) estimated heritabilities of 0.60, 0.18 and 0.53 for body weight, egg number at 15 first weeks and egg weight, respectively. Mass selection on annual egg records has long been regarded as ineffective, while selection based on family records and progeny testing has seemed to be the key to success (Nordskog et al., 1967). Cundiff (1977) indicated that reciprocal recurrent selection was slightly more effective than intra-population selection. Animal model best linear unbiased prediction (BLUP) of breeding values is becoming the method of choice for genetic evaluation in most livestock species. Animal model BLUP uses information from all relatives and simultaneously estimates the fixed effects. Thus BLUP evaluations are the most accurate estimates of breeding values available. In the short term, maximum accuracy should lead to maximum response, but, by maximizing use of information from relatives, BLUP also leads to high correlations of estimated breeding values of close relatives, giving high co-selection probabilities and increased rates of inbreeding. Sorensen (1988) simulated a pig breeding structure and found that BLUP selection gave 4% to 30% increases in response over selection indexes, depending on the heritability and the exact model used for index selection. Robinson (1991) showed that the best linear unbiased prediction (BLUP) is a technique for predicting genetic merits of animals. Jeyaruban et al. (1995) reported that the use of best linear unbiased prediction (BLUP) induced larger inbreeding rate compared to selection response especially for traits of low heritability. Contrarily, BLUP is an effective way of ranking and selecting animals given measurements on multiple traits of their own performance and information of their relatives, and it provides an effective alternative to the conventional selection index, which can be seen as a particular case of the BLUP estimates of random effects (Xie and Xu, 1996). Poultry breeders are often concerned with egg mass and its component traits with regard to estimate the heritability and selection response from data undergoing early culling or selection. Responses observed in most selection experiments with egg mass as selection criterion suggested a slightly increased of direct response than correlated response. The same findings had seen in the corresponding selected sub-line of White Leghorn (Venktramaiah *et al.*, 1986) they also reported that the egg mass selected sub-line matured later and lay heavier but slightly less numerous eggs. However, egg mass is estimated to be a low heritable trait ranged from 0.05 to 0.16 (Quadeer *et al.*, 1977 and Venktramaiah *et al.*, 1986). The objective of this study is to use the best linear unbiased prediction method (BLUP) in predicting the breeding values of body weight, keel length and breast circumference and to use this information for increasing the selection response of egg mass in Inshas strain of chicken.

MATERIALS AND METHODS

The present experiment had been carried out at Sakka Research Station, Animal Production Research Institute, Agriculture Research Center, Egypt.

Experimental Stock and Design: Data used in the present study were extracted from a flock of Inshas hens. Measurements were recorded on 225, 224 and 293 laying hens in three successive generations. The laying hens were kept in battery cages, and individual egg production was recorded daily from start of lay to 5 months of production. Only hens with complete records were included in the statistical analysis. The selected dam that used to construct the next generation were kept in family pens and assigned by 10 females per each male.

All managerial practices were similar as possible throughout the experiment. During the production period, the pullets were fed a commercial layer ration (16.5 % CP and 2750 Kcal) and received 16 hr day light. The eggs were recorded and weighed daily through the experimental period.

The traits which construct the phenotypic variance-covariance matrices are:

Body weight at hatch (BWH),
Body weight at 4 weeks of age (BW4),
Body weight at 8 of age (BW8),
Body weightat12 weeks of age (BW12),
Shank length at 12 weeks of age (SL),
Keel length at 12 weeks of age (KL),
Breast circumference at 12 weeks of age (Br),
Body weight at sexual maturity (BWSM),
Age at sexual maturity (ASM),
Early egg number: Number of eggs at 1st 90 d. of laying (EN1),
Early egg weight: Average egg weight through the 1st 90 d. of laying (EW1),
Egg mass at 90 d. of laying (EM1),
Number of eggs at 150 d. of laying (EN2),
Average egg weight at 150 d. of laying (EW2),
Egg mass at 150 d. of laying (EM2).

Statistical Analysis: The data were set up to Mixed Model Equations for the prediction of breeding values and the estimation of variance components using group observations, according to Olsen *et al*. (2006).

The model in matrix notations was:

$$\boldsymbol{Y = Xb + Zu + e}$$

Where: $\boldsymbol{Y}$ is the vector of observations, $\boldsymbol{b}$ and $\boldsymbol{u}$ are the vectors of fixed and random effects, with their respective incidence matrices ***X*** and ***Z***, and ***e*** a vector of random environmental effects.

Under this model, $E(Y) = Xb$, $E(u) = 0$ and $E(e) = 0$,

$Var(Y) = Var(u) + Var(e)$, which after substitutions, becomes $Var(Y) = ZGZ' + R$, with $Var(u) = G = A\sigma^2 a$, where ***A*** is additive genetic relationship matrix,

$\sigma^2 a$ is the additive genetic variance and $Var(e) = R = I\sigma^2 e$, where **I** is an identity matrix (i.e. assuming that there are no residual correlations between birds of the same group) and $\sigma^2 e$ random environmental variance.

The distribution of random factors is:

$$\begin{vmatrix} u \\ e \end{vmatrix} = N \begin{vmatrix} 0 \\ 0 \end{vmatrix} \begin{vmatrix} A\sigma^2 u & 0 \\ 0 & I\sigma^2 e \end{vmatrix}$$

The best linear unbiased prediction solutions for fixed and random effects can be obtained by solving the usual Mixed Model Equations given by (Henderson, 1975; 1984).

$$\begin{vmatrix} X`X & X`X`Y \\ Z`X & Z`Z+\lambda A^{-1} \end{vmatrix} \begin{vmatrix} \hat{b} \\ \hat{u} \end{vmatrix} = \begin{vmatrix} Z \\ Z`Y \end{vmatrix}$$

λ is the ratio $\sigma^2 e/\sigma^2 u$

The (Co) variance estimates were obtained with REML individual animal model using the DEREML software (Meyer, 1989).

-The realized genetic gain (ΔRG_t) from generation 0 to t may be expressed as:

(ΔRG_t) = $(S_t - S_0) - (C_t - C_0)$, (Hill, 1972),

Where: S and C indicate the mean of the selected and the control lines.

-Selection differential **(S)** was calculated as the difference between the average of the selected birds as parents for a certain trait and the average of their population,

-Selection intensity (**I**) = Selection differential (**S**) / Standard deviation of the trait,

-Expected genetic gain **(ΔEG)** = (**S**) Selection differential x (h^2) Heritability, were estimated according the equations of (Falconer, 1982).

RESULTS AND DISCUTIONS

***Mean performance*:** Within the base generation G0 means and standard deviations for the studied traits were given in Table, 2. The results showed superiority of selected line means in (BWH, BW4, BW8, BW12, KL, BWSM, EW1 and EW2) 32.7±2.4 g, 174.2±41.7 g, 542.3±124.8 g, 850.7±189.9 g, 7.1±0.8 cm., 1423±174 g, 43.7±4.2 g, and 45.4±4.7 g, compared with the control 32.5±2.1 g, 171.2±30.7 g, 521.8±98.1 g, 831.8±152 g, 6.9±0.8 cm, 1400±145 g, 42.9±4.4 g, and 44.2±4.5 g, respectively. The reverse situation was found in the control line in the traits (SL, Br, ASM, EN1, EM1, EN2 and EM2) 6.3±1.0 cm, 20.3±2.7 cm, 184±21.9 d, 62.6±9.5 egg, 1127.5±372 g, 48±17.7 egg and 2108.4±74.3 g, respectively. The same manner was found in the first generation G1, where the performance of the selected line was higher than the corresponding control in the traits (BWH, BW4, BW8, BW12, SL, Br, EW1 and EW2) 35.5±2.8 g, 187.2±48 g, 603.7±142 g, 914.8±144 g, 5.8±0.7 cm, 17.5±1.8 cm, 43.6±3.9 g and 46.2±3.7 g, vs. 32.9±2.3 g, 170.5±43.6 g, 531.3±119.8 g, 856.1±117.9 g, 5.7±0.6 cm, 16.9±1.2 cm 43.0±3.5 g, and 44.3±2.8 g, respectively. Regarding body weight in the second generation G2, it was clear that the control line exceeded the selected line except for BWH 33.6 vs. 33.5 g, while the traits SL, KL and Br were 5.9, 7.0 and 18.5 cm in the selected line, the corresponding means in the control line were 5.6, 6.8 and 17.1 cm, respectively. The results showed clearly that the change in early egg weight (EW1) the selected line in G0 was higher than the corresponding the control by 0.8 g, while the change in mature egg weight (EW2) was 1.2 g. In the first selected generation G1 the selected line early egg weight (EW1) improved by 0.6 g, while the change was 1.9 g in mature egg weight (EW2). Moreover, the control line exceeded the selected line in egg number at 90 d. of production (EN1) and egg number at 150 d. of production (EN2).

Regarding egg mass at 150 d, of production (EM2) and its component traits EN2 and EW2 (Table 2), it can be seen that the mean of egg mass at 150 d., of production (EM2) in the control line was affected mainly by the large proportion of variations in egg number at 150 d, of production (EN2), since the change in G0 was observed in EM2 658.7 g, combined with decrease EN2 by 16 eggs. The same manner was found in G1 the control line 731 g, and 17 eggs, respectively. The former result showed that there was a correlation between egg number and egg mass. The same finding was reported by Abou El-Ghar *et al*., (2010).

***Phenotypic and Genetic change*:** The results obtained in Table 3, it obvious that selection differential (S) estimates in G0 were 0.2, 3.0, 20.5, 18.9 g, -0.3, 0.2, -0.8 cm, 23.0 g, 6.0 d, -11.6 egg, 0.8 g, -467 g, -16 egg, 1.2 g, and -658 g, for BWH, BW4, BW8, BW12, SL, KL, Br, BWSM, ASM, EN1, EW1, EM1, EN2, EW2 and EM2, respectively. In addition, the selection differential (S) estimates in G1 were 2.6, 16.7, 72.4, 58.7 g, 0.1, -0.1, 0.6 cm, -9.0 g, 12.0 d, -16.0 egg, 0.6 g, -668 g, -17.0 egg, 1.9 g, and -731 g, for BWH, BW4, BW8, BW12, SL, KL, Br, BWSM, ASM, EN1, EW1, EM1, EN2, EW2 and EM2, respectively. Moreover, the selection differential in G2 were 0.1, -5.5, -66.0, -94.6 g, 0.3, 0.2 and 1.4 cm for BWH, BW4, BW8, BW12, SL, KL and Br, respectively. Selection intensities (I) for the studied traits in G0 and G1 were shown in table 3, these results reveal fairly good selection intensities for body weights and egg weights either in early period at 90 d of production or in later period at 150 d of production. From the results obtained it was clear that BLUP provides an effective way of ranking and selecting birds given measurements on body weights and egg weights traits. The same conclusion reported by (Xie and Xu, 1996). In the second selected generation G2, good selection intensities for SL, KL and Br, respectively. The case of egg number and egg mass, the selection intensities in G0 and G1 were lowered in the early period and the later period. These findings agreed with those reported by Bohren (1970) who reported that the importance of negative genetic correlation between egg weight and egg production in chickens is well known and has estimated interest in egg mass.

The realized genetic gain (ΔRG) estimated demonstrates a considerable genetic improvement not only in selected line but also in the control line. However, when the mean of selected line was adjusted by subtracting the mean of the appropriate control within generation, the realized genetic gain in the studied traits in G1 were 2.4, 13.7, 51.9, 39.9 g, 0.3, and 1.4 cm, for BWH, BW4, BW8, BW12, SL and Br, respectively. Moreover, the expected genetic gains (ΔEG) were 2.0, 3.9, 19.0, 11.0 g, 0.1 and 1.0 cm, for BWH, BW4, BW8, BW12, SL and Br, respectively. The realized genetic gains in G2 were -0.1, -8.4, -86.5, -113.5 g, 0.6, -0.08 and 2.1 cm, for BWH, BW4, BW8, BW12, SL, KL and Br, respectively, while the expected genetic gains (ΔEG) were 0.003, 1.6, 82.4, 155.3, 0.4, 0.004 and 1.3 for BWH, BW4, BW8, BW12, SL, KL and Br, respectively. In fact the disagreement between expected and realized genetic gain is probably because of a reduction in additive genetic variance and consequently low estimates of heritability. Other factors such as small population size, inbreeding, drift change in fitness and/or approach to genetic/physiological limits might also influence the rate of response. The same conclusion was reported by (Quinton *et al*., 1992; Quinton and Smith, 1995 and Sharma *et al*., 1998). It was clear that EM2 showed a reduction per generation in spite of egg weight, this was probably due to the antagonism between body weight and egg number. The same finding was found by (Verma *et al*., 1984) who reported that direct selection for any trait resulted in maximum response in that particular trait. Contrarily, such results indicated that the direction of the genetic correlation between partial and full egg record could change in the course of selection. The same conclusion was found by Bohren *et al*., 1966 and Bohren, 1970.

Phenotypic and Genetic parameters: Knowledge of genetic parameters such as heritability and genetic correlations are needed to predict response of selection and to estimate the economic returns of selection. The results in Table 4 indicate relatively low heritability estimates in G0 0.08, 0.07, 0.2, 0.1 and 0.1 for BWH, BW4, BW8, BW12 and BWSM, respectively. The interpretation of these results was reported by Eisen *et al.* (1973) who found that the smaller population sizes or closed flocks tend to decrease selection response and realized heritability. The results of heritabilities of SL, KL, Br, ASM, EW1, EN2 and EW2 were moderate to low 0.3, 0.3, 0.4, 0.4, 0.2, 0.02 and 0.3, respectively. The egg mass were high (EM1) 0.6 and (EM2) 0.9. The heritability estimated were harmony with those (from 0.05 to 0.16) reported by Quadeer *et al.* (1977). In G1 the heritability estimates were ranged between moderate 0.3 (BW12) to high 0.9 (EN1), while EW1, EM1, EN2, EW2 and EM2 had low heritability estimates 0.06, 0.08, 0.1, 0.2 and 0.1, respectively. The heritability estimates were 0.03, 0.2, 0.9, 0.4, 0.6, 0.05 and 0.6 for BWH, BW4, BW8, BW12, SL, KL and Br in G2, respectively. Contrarily, the results of heritability estimates for egg number and egg weight were lower than those reported by (Enab *et al.*, 1992; Abdou and Enab, 1994 and El-Wardany, 1999).

As shown in Table 4, in G0 the phenotypic correlation estimates were high and positive between EN1, EM1 and EN2 and egg mass at 150 d of production (EM2) i.e. 0.82, 0.83 and 0.98, respectively. The same finding was reported by Abou El-Ghar *et al*., (2010). On the other hand, egg mass (EM2) and egg weight were low correlated

-0.1 and -0.08 either for part period (90 d of production) or full period (150 d of production). These results were confirmed with findings of Garwood and Lowe (1978). They reported that egg mass was increased solely through change in egg weight. In despite of the low phenotypic correlation between egg weight and egg mass, and the antagonism between egg number and egg weight, it is desirable to improve both egg number and egg weight simultaneously in the commercial stocks. The phenotypic correlations were low and negative between BWH, BW4, SL, BWSM and ASM and EM2 i.e. -0.02, -0.02, -0.09, -0.18 and -0.4, respectively. BW8, BW12, KL and Br had low phenotypic correlations between them and EM2 i.e. 0.14, 0.05, 0.02 and 0.04, respectively. The same manner were found in G1 which the phenotypic correlation estimates were high and positive between EN1, EM1 and EN2 and EM2 i.e. 0.8, 0.8 and 0.97, respectively. The phenotypic correlations were low and positive between BWH, BW4, BW12 and BWSM and EM2 i.e. 0.004, 0.07, 0.1 and 0.06, respectively. The phenotypic correlations were low and negative between SL, KL, Br and ASM and EM2 i.e. -0.001, -0.06, -0.03 and -0.3, respectively.

The results in Table 4 showed also the economic importance of negative genetic correlations between egg mass and egg production traits in Inshas chicken. However, in G0 the low and negative genetic correlation estimates were found among most of the trait relationships ranged from -0.001 for between BWH and EN2 to -0.57 between EN1 and EM2. The genetic correlations were low and positive between BW8, BW12, SL, KL and EN2 and EM2 i.e. 0.02, 0.005, 0.03, 0.006 and 0.02, respectively. Moreover, in G1 the total egg mass (EM2) and BWSM, ASM, EN1, EW1, EM1 and EN2 were negatively correlated genetically -0.01, -0.12, -0.7, -0.007, -0.06 and -0.13, respectively. The same findings were reported by (Quadeer *et al.,* 1977; and Francesch *et al.,* 1997). The phenotypic correlations were low and positive between BWH, BW4, BW8 and BW12 and EM2 i.e. 0.003, 0.006, 0.04 and 0.02, respectively.

In conclusion, the Egyptian farmers reared local chicken for the purpose of increasing body weight as well as egg production traits. Inshas strain was known as dual purpose breed with respect to consumer. The great genetic potential of body weight traits will be helpful for genetic improvement of the objective traits through selection. From the results of the present study, it was obvious that selection was effective in improving body weight traits studied by the generation (G1) of study. The heritability estimates in this study were moderate to high for most of the traits studied. This is an encouraging factor for more intense selection within the Inshas local chicken population.

Table (1): The description of the data set used in the analyses was presented in the following

Item	**Generation**		
	G0	G1	G2
No. of total hens	225	224	293
No. of selected dams	100	50	60
No. of control hens	125	174	233

Where: G0= base generation, G1= first generation and G2= second generation

Table (2): Means ± S.D of body weight, keel length, breast circumference and some egg production traits in three successive generations

Traits	Generations					
	G0		G1		G2	
	S	C	S	C	S	C
BWH	32.7±2.4	32.5±2.1	35.5±2.8	32.9±2.3	33.6±3.3	33.5±3.2
BW4	174.2±41.7	171.2±30.7	187.2±48	170.5±43.6	166.3±42.9	171.8±34.6
BW8	542.3±124.8	521.8±98.1	603.7±142	531.3±119.8	458.9±91.0	524.9±105
BW12	850.7±189.9	831.8±152	914.8±144	856.1±117.9	738.2±83.0	832.8±123
SL	6.0±1.0	6.3±1.0	5.8±0.7	5.7±0.6	5.9±0.9	5.6±0.6
KL	7.1±0.8	6.9±0.8	6.9±0.7	7.0±0.6	7.0±1.4	6.8±0.6
Br	19.5±2.1	20.3±2.7	17.5±1.8	16.9±1.2	18.5±3.6	17.1±1.4
BWSM	1423±174	1400±145.8	1389±149	1398±149		
ASM	190±16.2	184±21.9	195±15.4	183±18.3		
EN1	15.0±6.8	26.6±9.5	11.0±4.4	27.0±10.0		
EW1	43.7±4.2	42.9±4.4	43.6±3.9	43.0±3.5		
EM1	651±289	1127.5±372	470.3±176	1138.2±435		
EN2	32±15.7	48±17.7	30.0±11.5	47.0±10.5		
EW2	45.4±4.7	44.2±4.5	46.2±3.7	44.3±2.8		
EM2	1449.7±712	2108.4±743	1385±529	2116±506		

G0 = base population, G1 = first selected populations, G2 = second selected populations, S = selected, C = control, BWH = body weight at hatch, BW4 = body weight at four weeks of age, BW8 = body weight at eight weeks of age, BW12 = body weight at twelve weeks of age, SL = shank length, KL = keel length, Br = breast circumference, BWSM = body weight at sexual maturity, ASM = age at sexual maturity, EN1 = number of eggs at 1st 90 d. of laying, EW1 = average egg weight through the 1st 90 d. of laying, EM1 = egg mass at 90 d. of laying, EN2 = number of eggs at 150 d. of laying, EW2= average egg weight at 150 d. of laying, EM2 = egg mass at 150 d. of laying.

Table(3): Selection differentials **S**, Selection Intensities **I**, the realized genetic gains **ΔRG** and expected genetic gains **ΔEG** of the studied traits

Traits	**G0**		**G1**				**G2**			
	S	**I**	**S**	**I**	**ΔRG**	**ΔEG**	**S**	**I**	**ΔRG**	**ΔEG**
BWH	0.2	0.08	2.6	0.9	2.4	2.0	0.1	0.03	-0.1	0.003
BW4	3.0	0.07	16.7	0.3	13.7	3.9	-5.5	-0.12	-8.4	1.6
BW8	20.5	0.16	72.4	0.5	51.9	19.0	-66.0	-0.72	-86.5	82.4
BW12	18.9	0.10	58.7	0.4	39.9	11.0	-94.6	-1.14	-113.5	155.3
SL	-0.3	-0.29	0.1	0.01	0.3	0.1	0.3	0.32	0.6	0.4
KL	0.2	0.32	-0.1	-0.2	-0.4	0.2	0.2	0.12	-0.08	0.004
Br	-0.8	-0.36	0.6	0.3	1.4	1.0	1.4	0.38	2.1	1.3
BWSM	23	0.13	-9.0	-0.06	-31.3	6.5				
ASM	6.0	0.40	12.0	0.77	5.4	1.9				
EN1	-11.6	-1.7	-16.0	-3.5	-4.0	3.6				
EW1	0.8	0.19	0.6	0.15	-0.2	0.01				
EM1	-476	-1.6	-668	-3.7	-191	207				
EN2	-16.0	-1.02	-17.0	-1.5	-1.6	0.2				
EW2	1.2	0.26	1.9	0.5	0.7	0.1				
EM2	-658	-0.92	-731	-1.3	-72.6	10.0				

G0 = base population, G1 = first selected populations, G2 = second selected populations, S = selection differential, I = selection intensities, ΔRG = the realized genetic gains, ΔEG = expected genetic gains, BWH = body weight at hatch, BW4 = body weight at four weeks of age, BW8 = body weight at eight weeks of age, BW12 = body weight at twelve weeks of age, SL = shank length, KL = keel length, Br = breast circumference, BWSM = body weight at sexual maturity, ASM = age at sexual maturity, EN1 = number of eggs at 1st 90 d. of laying, EW1 = average egg weight through the 1st 90 d. of laying, EM1 = egg mass at 90 d. of laying, EN2 = number of eggs at 150 d. of laying, EW2= average egg weight at 150 d. of laying, EM2 = egg mass at 150 d. of laying.

Table(4): Heritability **h²**, phenotypic **r_p** and genetic **r_G** correlations between egg mass at 150 d., of production and other studied traits

Traits	h²			r_p		r_G	
	G0	**G1**	**G2**	**G0**	**G1**	**G0**	**G1**
BWH	0.08	0.9	0.03	-0.02	0.004	-0.001	0.003
BW4	0.07	0.3	0.2	-0.02	0.02	-0.001	0.006
BW8	0.2	0.4	0.9	0.14	0.1	0.02	0.04
BW12	0.1	0.3	0.4	0.05	0.07	0.005	0.02
SL	0.3	0.4	0.6	-0.09	-0.001	0.03	-0.0005
KL	0.3	0.6	0.05	0.02	-0.06	0.006	0.03
Br	0.4	0.7	0.6	0.04	-0.03	-0.01	-0.02
BWSM	0.1	0.2		-0.18	0.06	-0.02	-0.01
ASM	0.4	0.4		-0.4	-0.3	-0.2	-0.12
EN1	0.7	0.9		0.82	0.8	-0.57	-0.7
EW1	0.2	0.06		-0.1	0.1	-0.02	-0.007
EM1	0.6	0.08		0.83	0.8	0.54	-0.06
EN2	0.02	0.1		0.98	0.97	0.02	-0.13
EW2	0.3	0.2		-0.08	0.1	-0.2	0.02
EM2	0.9	0.1					

h² = heritability, r_p = phenotypic correlations, r_G = genetic correlations, G0 = base population, G1 = first selected population, G2 = second selected populations, BWH = body weight at hatch, BW4 = body weight at four weeks of age, BW8 = body weight at eight weeks of age, BW12 = body weight at twelve weeks of age, SL = shank length, KL = keel length, Br = breast circumference, BWSM = body weight at sexual maturity, ASM = age at sexual maturity, EN1 = number of eggs at 1st 90 d. of laying, EW1 = average egg weight through the 1st 90 d. of laying, EM1 = egg mass at 90 d. of laying, EN2 = number of eggs at 150 d. of laying, EW2= average egg weight at 150 d. of laying, EM2 = egg mass at 150 d. of laying.

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الملخص العربي

تأثير الانتخاب المبكر لوزن الجسم وطول عظمة القص ومحيط الصدر على صفات إنتاج البيض فى دجاج إنشاص

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دجاج إنشاص تم إخضاعة للإنتخاب المبكر لوزن الجسم وطول عظمة القص ومحيط الصدر لمدة دورة واحدة وتأثير ذلك على صفات إنتاج البيض. ولقد أستخدم أفضل متنبئ خطي غير متحيز للتنبؤ بالقيم التربوية وترتيب ثم إنتخاب الدجاجات. ولقد كان الفارق الإنتخابى فى الجيل الأول G1 يساوى ٢,٦ ، ١٦,٧ ، ٧٢,٤ ، ٥٨,٧ جرام ، ٠,١ ، -٠,١ ، ٠,٦ سم ، ٩,٠ جرام ، ١٢,٠ يوم ، -١٦ بيضة ، ٦,٠ جرام ، -٦٦٨ جرام ، -١٧ بيضة ، ١,٩ جرام و -٧٣١ جرام لصفات وزن الجسم عند الفقس ، وزن الجسم عند ٤ أسابيع من العمر ، وزن الجسم عند ٨ أسابيع من العمر ، وزن الجسم عند ١٢ اسبوع من العمر ، طول عظمة الساق ، طول عظمة القص ، محيط الصدر ، وزن الجسم عند النضج الجنسي ، العمر عند النضج الجنسي ، عدد البيض عند ٩٠ يوم من الإنتاج ، وزن البيض عند ٩٠ يوم من الإنتاج ، كتلة البيض عند ٩٠ يوم من الإنتاج ، عدد البيض عند ١٥٠ يوم من الإنتاج ، وزن البيض عند ١٥٠ يوم من الإنتاج وكتلة البيض عند عمر ١٥٠ يوم من الإنتاج على التوالى. هذه القيم تعادل ٠,٩ ، ٠,٣ ، ٠,٥ ، ٠,٤ ، ٠,٠١ ، -٠,٢ ، ٠,٣ ، -٠,٠٦ ، ٠,٧٧ ، -٣,٥ ، ٠,١٥ ، -٣,٧ ، -١,٥ ، ٠,٥ و -١,٣ مقدرة بوحدات إنحراف قياسى على التوالى. فى حين زادت الإستجابة المتحققة للإنتخاب عن الإستجابة المتوقعة لصفة وزن الجسم عند الفقس ، وزن الجسم عند عمر ٤ أسابيع ، وزن الجسم عند عمر ٨ أسابيع ، وزن الجسم عند عمر ١٢ أسبوع ، طول عظمة الساق ، محيط الصدر ، العمر عند النضج الجنسي ، وزن البيضة عند ١٥٠ يوم من الإنتاج ٢,٤ ، ١٣,٧ ، ٥١,٩ ، ٣٩,٩ ، ٠,٣ ، ١,٤ ، ٥,٤ ، ٠,٧ مقابل ٢,٠ ، ٣,٩ ، ١٩,٠ ، ١١,٠، ٠,١ ، ١,٠ ، ١,٩ و ٠,١ . وتشير نتائج الدراسة الحالية الى أن الإنتخاب لصفات وزن الجسم كان فعالا فى الجيل الأول G1. ولقد قدر المكافئ الوراثى لمعظم الصفات المدروسة قيما متوسطة إلى مرتفعة وهذا عامل مشجع لزيادة الإنتخاب داخل سلالة إنشاص.