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# SELECTION FOR IMPROVING EGG PRODUCTION IN MANDARAH CHICKENS TO MAXIMIZE THE NET INCOME.

## 2. Correlated responses, heritability, genetic and phenotypic correlation among egg production and growth traits.

**By**

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**Abstract:** *The present study was conducted to estimate the correlated responses, the genetic parameters (heritability, genetic and phenotypic correlations) of some egg and growth traits in Mandarah chickens selected for improving egg number at the first 90 days of laying along two successive generations. Results showed that selection increased body weight at hatch (BW0) 1.2 gm, but decreased body weight at 4 weeks (BW4) 6.28 gm and growth rate at different periods. Estimates of heritability were 0.68 and 0.45 for ASM and for BWSM (0.39 and 0.16 ), EN (0.32 and 0.34), EW (0.68 and 0.22), EM (0.26 and 0.35), BW0 (0.08 and 0.10), BW4 (0.23 and 0.50 ), BW8 (0.24 and 0.29) for both the selected the control lines, respectively. Genetic increases in egg number in the selected line were positively associated with egg mass (0.81), while BW at 8 weeks of age (-0.33), ASM (-0.33) and EW (-0.39) were negatively associated with egg number. There were low relationship between EN and the other traits studied. Genetic correlations between the other egg and body weight traits showed a different genetic pattern in both selected and control lines. It could be concluded that selection for increased egg number during the first 90 days of laying in Mandarah strain decreased body weight and growth rate at different age. Heritability estimates based on sire component were higher for the selected line than the control one, which indicated that selection affected the heritabilty estimates.*

## INTRODUCTION

A knowledge of genetic parameters is one of the bases for decide the best selection program. Response to selection is a function of intensity of selection, phenotypic variance and heritability and in theoretically it should decline after continuous selection over generations because of exhausting the additive genetic variance (Bulmer, 1971). A wide range of heritability

($h^2$) estimates of egg production traits have been cited by many researchers (Wei and van der Werf, 1995; Francesch *et al.*, 1997; Hartman *et al.*, 2003, Chen and Tixier-Boichard, 2003) working on exotic strains, Abdellatif and Elhammady (1992); Abdou and Enab (1994); Kosba *et al.* (2002), Saleh *et al.* (2002), Ghanem (2003), Abdou (2006) and Abdella (2006) on local strains. Weight at sexual maturity had different $h^2$ estimates (Emsley *et al.*, 1977; Singh *et al.*, 1986; working on exotic strains and Abdellatif and Elhammady (1992), Abd El-Halim (1999) using local strains. Also, different $h^2$ estimates were reported concerning body weight at different ages (Kosba *et al.*, 2002 and 2006; Saleh *et al.*, 2002; Abdou, 2006). Genetic and/or phenotypic correlations among production and reproduction traits have been studied by Balat *et al.* (1995), Francesch *et al.* (1997), Sewalem and Wilhelmson (1999), Hartmann *et al.* (2003) working on foreign strains of chickens and those using local strains were El-Wardany and Abdou (1993), Younis and Abd-El Ghany (2004) and Abdella (2006).

The purposes of this study were estimate the heritability of egg production and some growth traits for selected and non selected lines of Mandara strain, beside estimating the genetic and phenotypic correlations among these traits. Also estimating correlated response to selection program to developing egg number during two generations, was also an aim of this study.

## MATERIAL AND METHODS

This study was conducted at El-Sabahiah Poultry Research Alexandria, Animal Production Research Institute, Agriculture Research Center through three successive years (2001-2002 to 3003-2004). Two lines of Mandarah strain were used in the present study. Selected line ( a total of 1146) and control line ( a total of 585) pedigreed unsexed one day chicks hatched over two generations (Table1). Selection was practiced from egg number up to 90 days of age using a family index that took into account the individual performance plus sire family averages for pullets, and for male were taken according to half sib mean of egg number.

The chicks were wing banded, weighed at hatch, 4 and 8 weeks of age, brooded and fed a starter diet (19% crud protein and 2800 Kcal) up to 8 weeks of age, grower diet (15% CP and 2700 Kcal) up to 20 weeks and layer diet (16.5% CP and 2750 Kcal ), there after, feed and water were supplied *ad libitum.*

Sexes were separated at 8 weeks of age and birds were reared to 20 weeks of age under the same condition as **Ghanem *et al.* (2007).** The pullets were housed in individual laying cages at 20 weeks of age. After 90 days of laying the pullets were housed in breeding been, 7 to 11 sire family were used in each generation to produced the pedigree chicks. Three or four weekly hatches were taken in each generation where all experimental birds and hatching eggs received the same managerial treatments.

**Studied traits:**

- Body weight at different ages (0, 4, 8), in grams,
- Growth rate for different periods (0-4), (4-8), (0-8) for lines and generation was calculated by the following formula (Brody, 1945).
- Body weight and age at first egg set, egg number, egg weight and egg mass at the first 90 days of laying

**Statistical analysis:**

Data of percentages were translated to Arc sine values before analysis (SAS Institute, 1988).

All data (except BW at 8 weeks of age) were analyzed using fixed models (SAS Institute, 1988):

$$Y_{ijk} = \mu + G_i + L_j + (GL)_{ij} + e_{ijk}$$

Where: $Y_{ijk}$= an observation, $\mu$ = overall mean, $G_i$ = the fixed effect of $i^{th}$ generation, $L_j$ = the fixed effect of $j^{th}$ line, $(GL)_{ij}$ = effect of the interaction between G and L, and $e_{ijk}$ = random error.

Data of BW at 8 weeks of age were analyzed using the following model (SAS, 1988):

$$Y_{ijk} = \mu + G_i + L_j + S_k + (GL)_{ij} + (GS)_{ik} + (LS)jk + (GLS)_{ijk} + e_{ijkl}$$

Where: $Y_{ijk}$= an observations, $\mu$ = overall mean, $G_i$ = the effect of $i^{th}$ generation, $L_j$ = the effect of $j^{th}$ line, $S_k$ the effect of $k^{th}$ sex, and $(GL)_{ij}$, $(GS)_{ik}$, (LS)jk and GLS $_{ijk}$ are the interactions between the main effects studied, and $e_{ijk}$ = random error.

Significant differences among means were tested by Duncan Test (1955).

The realized genetic gain per generation was estimated as a deviation of the selected line mean from the control line mean according to the following equation

$$R_t = (S_t - S_{t-1}) - (C_t - C_{t-1})$$

Where: $R_t$ realized gain due to selection in the $t^{th}$ generation and S and C averages performance of the selected and the control populations (Guill and Washburn, 1974).

**Genetic parameter:**

Heritability was estimated according to the following model:

$Y_{ij} = \mu + S_i + e_i$

Where: $\mu$: the overall mean, $S_i$ = the fixed effect of $i^{th}$ sire, $G_j$ the fixed and $e_{ij}$ = the random error.

Heritability estimates was calculated according to Becker (1985):

$h^2_S = 4 \text{ Var (S)} / \{(\text{Var (S)} + \text{Var (E)}\}$

Where $h^2_S$ is the heritability estimate, Var(S) = the sire variance components,

Var (E) = the error variance component.

The heritability and genetic and phenotypic correlation coefficients obtained from sire component of variance were estimated according to (Harvey, 1990).

## RUSELT AND DISCUSION

**Growth traits:**

Body weight at hatch was decreased significantly ($p<0.01$) in the $2^{nd}$ generation than the $1^{st}$ one in both lines, Table 2. Chicks for the selected line in the two generations were heavier ($p<0.01$) compared to the control ones at hatch and 4 weeks of age, also males in the two lines had heavier weight than females at 8 weeks of age. The realized correlated response was (1.2, -6.28 and –19.68) at hatch, 4 weeks and males at 8 weeks of age, respectively, Table (3). These results of body weight are agreement with those obtained at different ages by El-Tahawy (2000) and Kosba *et al.* (2002). No significant difference between growth rate during the early period of growth (0 to 4 wks) in the two lines were found, while chicks of the first generation grew significantly faster ($p<0.01$) than those of the $2^{nd}$ one, Table 4. Growth rate averages of the $2^{nd}$ generation in both sexes from 4 to 8 weeks were higher compared to those of the $1^{st}$ one. The realized correlated response for growth rate was negative at different ages except at (4 to 8) for females (Table 3). These results are in the same range, with those reported by El-Tahawy (2000), Rizkalla and El-Hossari (2002) and Ghanem (2003). Which indicated that selection for egg number decreased body weight at 4 weeks, males at 8 weeks and growth rate at different periods.

**Genetic parameter:**

**Heritability**

The estimated $h^2$ for body weight at different ages for the selected and control lines are presented in Table (5). As for, selected line, $h^2$ estimates of body weight at 0, 4 and 8 weeks of age were 0.10, 0.50 and 0.64, respectively. The corresponding values for the control line were 0.08, 0.23 and 0.63, respectively. These results are in agreement with those reported by Ghanem (1995), Sabri and Abdel- Warith (2000), Enab (2000) and Kosba *et al.* (2002). Saatci *et al.* (2006) working on quail, reported that the heritabilities of weekly BW were low (0.18 to 0.25), and decreasing by 5 to 6 wk of age.

The estimates of heritability ($h^2$) based on sire component and standard errors of egg production traits for the selected and control lines are presented in Table (6). The $h^2$ estimates of age at sexual maturity (ASM) were high (0.68) and moderate (0.45) for selected and control lines, respectively). Result in the present study is higher than those reported by El-Full (2001), Ghanem (2003), Chen and Tixier–Boicard (2003) and Kosba *et al.* (2006). The estimate of $h^2$ of body weight at sexual maturity (BWSM) was moderate 0.39 for selected line and low 0.16 for the control one. These results are lower than those reported by Ghanem (2003) and Abdella (2006). Approximately equal values were found by Kosba *et al.* (2006). Moderate estimates of $h^2$ for egg number (EN) was found in both the selected and control lines (0.32 and 0.34), respectively. Similar estimates were found in the literature (Kosba *et al.*, 1997; Abd El-Halim, 1999; and Kosba *et al.*, 2002). Estimates of heritability reported by Francesch, *et al.* (1997) for egg number were 0.20 to 0.33 for the three breeds studied

The $h^2$ estimates for egg weight was high for the selected line (0.68), while it was low for the control one (0.22). This result was in agreement with those reported by El-Full (2001) and Enab *et al.* (2001). The estimated $h^2$ of Francesch *et al.* (1997) for egg weight, ranged from ( 0.48 to 0.59). Concerning egg mass, estimates of $h^2$ were 0.261 and 0.348 for both the selected and the control lines, respectively. These values were approximately similar with those reported by Abd-Alla (1997) and Abdella (2006). Generally, heritability estimates based on sire component were higher for the selected line than the control one. This result indicated that selection affected the heritability estimates as found by Sheble (1986) and Kosba *et al.* (2002) who reported that heritability increased by selection.

**Genetic correlations:**

Change in heritability and other parameters of population over many generations of selective breeding are necessary for an understanding of the problems involved in the formulation of efficient breeding plans for partial improved flocks Craft (1951).

Genetic correlation among body weight at the different ages studied for both selected and control lines were positive, low between BW at hatch and both BW4 and BW8 while that between BW4 and BW8 weeks were high (0.92 and 0.88), respectively Table 5. Kosba *et al.* (2006) found very low estimates of $r_G$ between BW0 and BW8.

The genetic correlation ($r_G$) estimates among egg production traits are presented in Table 6. For selected line, $r_G$ estimates for age at sexual maturity were positive and low with all egg production traits studied except with EN it was negative. There were positive and relatively low estimates of $r_G$ between BWSM and EN, EW, and EM, between EW and EM. Estimates of $r_G$ was negative and moderate between EN and EW (-0.39), while it was high with EM (0.81). Estimated genetic correlations reported by Francesch *et al.* (1997) between egg number and egg weight ranged from -0.19 to -0.22.

Concerning the control line, the $r_G$ of ASM were positive moderate with BWSM (0.430) high with EW (0.69) while they were negative and high (–0.64) with EN and EM (0.51). Estimates of $r_G$ between BWSM with both EN and EM traits were negative and low, while it was positive and high for EW. The $r_G$ was negative and moderate between EN with EW (-0.41), high with EM (0.93).

Generally, the highly genetic correlation between any two traits, indicated that selection in trait improve the other trait indirect.

**Phenotypic correlations:**

The simplest situation in which selection is directed towards single traits, whose phenotypic variance may be regarded as the sum of the additively genetic and residual, or environmental variances does not appear to offer any serious problem at the outset of a selection program (Lush 1945; Mather 1949 and Lerner 1950).

The $r_P$ estimates of both the selected and control lines were positive and moderate among BW traits studied except $r_P$ between BW4 and BW8 for the control line which had low estimated.

The phenotypic correlation $r_P$ estimates for the selected line, among all egg production traits were positive and varied between low and moderate estimates (0.13 – 0.42). Different results were found by Sheble *et al.* (1991), Enab *et al.*(2001) and Abdella (2006), Francesch *et al.* (1997) and Enab *et al.* (2001) Abdella (2006). Concerning the control line, results showed positive and low $r_P$ between ASM with all egg production traits which studied ,Table 6. Estimates of $r_P$ were positive and moderate between BWSM and both of EN, EW, and AM (0.52, 0.65 and 0.51), respectively. Egg number had positive and high $r_P$ (0.63) with EW, while it was low with EM. In addition, $r_P$ was positive and low between EW and EM. These results are in agreement with those reported by Enab *et al.* (2001).

**Genetic correlations among egg production and body weight traits:**

The genetic correlations among egg production and body weight traits for both selected and control lines are presented in Table 7. Positive and high $r_G$ was detected between BW4 and BWSM (0.62), while estimates were small with EN (0.12) and EM (0.10). The $r_G$ estimates were negative and low between BW4 and both ASM and EW (-0.33 and -0.01), respectively, concerning the selected line. As for the control one, also, $r_G$ between BW4 and BWSM was high (0.80) while estimates of $r_G$ with the other egg production traits were low and varied from positive and negative values.

Concerning $r_G$ between BW8 and egg production traits, all estimates were low and varied in signs for the selected line while for control line, BW8 had high estimates of $r_G$, positive (0.79) with BWSM and negative with EW (-0.62). The rest relationships were low. Saatci *et al.* (2006) found strong correlations between direct genetic effects for egg traits and maternal genetic effect for BW traits.

**Phenotypic correlations among egg production and body weight traits:**

The estimates of phenotypic correlation $r_P$ among egg production and body weight traits are presented in Table 8. Results showed positive but low $r_P$ values between BW4 and all egg production traits studied for both the selected and control lines except that with EW for control line which had moderate values (0.51). Concerning $r_P$ between BW8 and the aforementioned traits, there were positive and high (0.60) value with EW, moderate (0.40) with ASM in control line, moderate values of $r_P$ with both EW and EM (0.46 and 0.41), respectively, in selected line, while the other relationships of both the selected and control lines had low values

**Table (1)** Number of sires, dams and progeny which used in the selected program at the three generation

| Generation | Selected line | | | Control line | | |
|---|---|---|---|---|---|---|
| | Sires | Dams | Progeny | Sires | Dams | Progeny |
| G1 | 15 | 159 | 618 | 10 | 121 | 388 |
| G2 | 19 | 209 | 528 | 9 | 71 | 183 |
| Total | 34 | 368 | 1146 | 19 | 192 | 585 |

**Table (2):** Least squares means and standard errors of body weight at 0.4 and 8 weeks of age (BW0,BW4 and $BW_8$) for the males and females over two generations of selection

| Generation | | Selected line | | | Control line | | | Overall mean | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Traits | | Male | Female | Average | Male | Female | Average | Male | Female | Average |
| BW0 | G1 | - | - | 35.16 +0.13 | - | - | 35.00 +0.15 | - | - | 35.10 +0.10A |
| | G2 | - | - | 34.93 +0.12 | - | - | 33.57 +0.15 | - | - | 34.58 +0.1B |
| | Overall mean | - | - | 35.05 +0.09a | - | - | 34.54 +0.12b | - | - | |
| BW4 | G1 | - | - | 198.19 +1.94 | - | - | 186.15 +2.30 | - | - | 193.52 +1.50A |
| | G2 | - | - | 165.20 +1.66 | - | - | 159.44 +2.34 | - | - | 163.70 +1.38B |
| | Overall mean | - | - | 182.43 +1.39a | - | - | 177.03 +1.80b | - | - | |
| BW8 | G1 | 505.80 +7.69 | 396.01 +6.23 | | 468.56 +10.14 | 381.33+7.61 | | 492.66 +6.20 | 389.47 +4.85 | 439.81 +4.37 |
| | G2 | 503.26 +8.70 | 365.90 +4.80 | | 485.88 +8.66 | 349.15+7.01 | | 497.87 +6.59 | 362.17 +4.06 | 418.39 +4.59 |
| | Overall mean | 504.73+5.76 | 379.06 +3.89 | 436.39 +4.01 | 475.05 +7.13 | 371.21+5.74 | 418.23 +5.12 | 494.77 +76.22 | 376.22 +3.23 | |

Means within each row and column having similar letter are not significant at p<0.01G: generation

**Table (3):** Realized correlated response for growth traits in selected line by sex

| Traits | BW0 | BW4 | BW8 | GR (0-4) | GR (0-8) | GR (4-8) |
|---|---|---|---|---|---|---|
| Male | - | - | -19.86 | - | -3.25 | -2.33 |
| Female | - | - | 2.07 | - | -0.93 | 2.5 |
| Comb. sex | 1.2 | -6.28 | - | -4.22 | - | - |

**Table (4):** Least squares means and standard errors of growth rate during 0-8 wks (Gr0-8) and 4-8 wks (Gr4-8) intervals for the males and females over two generations of selection

| Generation | | Selected line | | | Control line | | | Overall mean | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Trait | | Male | Female | Average | Male | Female | Average | Male | Female | Average |
| Gr0-4 | G1 | - | - | 137.36+0.61 | - | - | 134.36+ 0.73 | - | - | 135.35 +0.54 |
| | G2 | - | - | 127.25+0.83 | - | - | 128.47+0.98 | - | - | 127.57+0.66 |
| | Overall mean | - | - | 131.52+0.53 | - | - | 131.33+0.60 | - | - | |
| Gr0-8 | G1 | 172.87 +0.43 | 165.64 +4.56 | | 170.70 +0.65 | 164.71 +0.68 | | 172.11 +0.37 | 165.23 +0.44 | 168.58+0.31 |
| | G2 | 172.37 +0.94 | 163.67 +0.51 | | 173.45 +0.49 | 163.67 +0.95 | | 172.37+0.94 | 163.67 +0. 51 | 167.41+0.42 |
| | Overall mean | 172.66 +0.47 | 164.53 +0.38 | 168.2 +0.33 | 171.73 +0.45 | 164.38 +0.55 | 176.71+0.41 | 172.35+0.66 | 164.48 +0.32 | |
| Gr4-8 | G1 | 80.00 +1.24 | 70.94 +1.34 | | 80.98 +1.54 | 74.52 +1.52 | | 80.34 +0.97 | 74.75 +1.00 | 77.48+0.71 |
| | G2 | 90.31 +1.88 | 79.21 +1.32 | | 93.44 +1.59 | 80.29 +1.76 | | 91.28 +1.39 | 79.45 +1.10 | 84.35+0.90 |
| | Overall mean | 84.34 +1.10 | 77.34 +0.95 | 80.53 +0.73 | 85.65 +1.21 | 76.33 +1.19 | 80.55 +0.88 | 84.78 +0.84 | 77.00 +0.75 | |

Means within each row and column having similar letter are not significant at $p<0.01$G: generation

**Table (5):** Heritability (diagonal) and genetic correlation (above diagonal) and phenotypic (below diagonal) between body weight traits for selected and control lines

| Trait | Selected line | | |
|---|---|---|---|
| | BW0 | BW4 | BW8 |
| BW0 | 0.10+0.05 | 0.32 | 0.15 |
| BW4 | 0.46 | 0.50+0.16 | 0.92 |
| BW8 | 0.52 | 0.09 | 0.64+0.12 |
| | Control line | | |
| BW0 | 0.08+0.06 | 0.27 | 0.13 |
| BW4 | 0.45 | 0.23+0.11 | 0.88 |
| BW8 | 0.45 | 0. 52 | 0.63+0.12 |

**Table (6):** Heritability (diagonal) genetic correlation (above diagonal) and phenotypic (below diagonal) between egg production traits for selected and control lines

| Traits | ASM | BWSM | EN | EW | EM |
|---|---|---|---|---|---|
| Selected line | | | | | |
| ASM | 0.68+0.24 | 0.31 | -0.33 | 0.04 | 0.32 |
| BWSM | 0.29 | 0.39+0.19 | 0.24 | 0.33 | 0.30 |
| EN | 0.34 | 0.39 | 0.32+0.18 | -0.39 | 0.81 |
| EW | 0.29 | 0.33 | 0.39 | 0.68+0.24 | 0.23 |
| EM | 0.37 | 0.42 | 0.13 | 0.34 | 0.26+0.17 |
| | Control line | | | | |
| ASM | 0.45+0.22 | 0.43 | -0.64 | 0.69 | -0.51 |
| BWSM | 0.37 | 0.16+0.14 | -0.03 | 0.56 | -0.08 |
| EN | 0.26 | 0.52 | 0.34+0.19 | -0.41 | 0.93 |
| EW | 0.42 | 0.65 | 0.63 | 0.22+0.14 | -0.04 |
| EM | 0.29 | 0.51 | 0.21 | 0.30 | 0.35+0.19 |

**Table (7):** Genetic correlation between body weight at 4 and 8 weeks of age and egg production traits for selected and control line

| Line | Selected line | | Control line | |
|---|---|---|---|---|
| Trait | Bw4 | Bw8 | Bw4 | Bw8 |
| ASM | -0.33 | -0.26 | 0.07 | 0.01 |
| BWSM | 0.62 | 0.30 | 0.80 | 0.79 |
| EN | 0.12 | -0.33 | 0.21 | -0.29 |
| EW | -0.10 | 0.01 | -0.30 | -0.62 |
| EM | 0.10 | -0.33 | 0.06 | 0.18 |

**Table (8):** Phenotypic correlation between body weight at 4 and 3 weeks of age and egg production traits for selected and control line

| Line | Selected line | | Control line | |
|---|---|---|---|---|
| Trait | Bw4 | Bw8 | Bw4 | Bw8 |
| ASM | 0.22 | 0.31 | 0.34 | 0.40 |
| BWSM | 0.17 | 0.31 | 0.23 | 0.34 |
| EN | 0.29 | 0.37 | 0.24 | 0.28 |
| EW | 0.35 | 0.46 | 0.51 | 0.60 |
| EM | 0.32 | 0.41 | 0.28 | 0.35 |

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## الملخص العربى

## الانتخاب لتحسين إنتاج البيض فى دجاج المندرة لتعظيم صافى العائد
## ١-الاستجابة المرتبطة ، المكافئ الوراثى ، الإرتباط الوراثى والمظهرى بين صفات البيض والنمو.

**ماجدة مصطفى بلاط ، نظلة يوسف أبو العلا ، أسامة محمود على و حنان حسن غانم**

معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية- وزارة الزراعة – الدقى

أجريت هذه الدراسة بهدف قياس الاستجابة المرتبطة والمعايير الوراثية (المكافئ الوراثى ، الارتباط الوراثى والظاهرى لقطيع من سلالة المندرة تم انتخابه بغرض تحسين عدد البيض الناتج خلال ٩٠ يوم الأولى من الإنتاج خلال جيلين متعاقبين. أوضحت النتائج أن الانتحاب لتحسين عدد البيض أدى إلى .زيادة وزن الجسم عند الفقس ١.٢ جم بينما نقص وزن الجسم عند ٤ اسلابيع ٦.٢٨ جم و كذلك معدل النمو فى الفترات المختلفةز كانت قيم المكافئ الوراثى ٠.٤٥ و٠.٦٨ للعمر عند النضج الجنسى و ٠.١٦ و ٠.٣٩ لوزن الجسم عند النضج الجنسى و ٠.٣٤ و ٠.٣٢ لعدد البيض و٠.٢٢ لوزن البيضة و ٠.٣٥ و ٠.٢٦ لكتلة البيض و ٠.١٠ و ٠.٠٨٠ لوزن الجسم عند الفقس و ٠.٥٠ و ٠.٢٣ لوزن الجسم عند ٤ أسابيع و ٠.٢٩ و ٠.٢٤ لوزن الجسم عند ٨ أسابيع لكل من الخطين المقارن والمنتخب على التوالى. التحسين الوراثى فى صفة عدد البيض ارتبط إيجابيا بكتلة البيض (٠.٨١) بينما وزن الجسم عند ٨ أسابيع (-٠.٣٣) و العمر عند النضج الجنسى (-٠.٣٣) و (-.٣٩) لوزن البيضة حيث كان الارتباطات الوراثية بعدد البيض سالبة. وكانت قيم الارتباط الوراثى بين عدد البيض وباقى الصفات التى تم دراستها منخفضة .أظهرت الدراثة تباينا فى قيم الارتباط الوراثى بين صفات البيض ووزن الجسم عند الأعمار المختلفة. وفقا لما سبق يمكن القول أن الانتخاب لزيادة عدد البيض خلال الـ ٩٠ يوم الأولى من الإنتاج فى سلالة المندرة أدى لنقص وزن الجسم و معدل النمو فى الأعمار المختلفة. كما ان ارتفاع قيمه المكافئ الوراثى على أساس الأب فى الخط المنتخب عن الخط المقارن يشير الى تأثر المكافئ الوراثى بالانتخاب.