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DIVERGENT SELECTION FOR EGG PRODUCTION IN JAPANESE QUAIL – DIRECT RESPONSES

By

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ABSTRACT:. A total number of 330 birds at 6 weeks of age were taken from the third generation of the base population to construct the generation number zero for selection. The birds were randomly assigned to three mating groups, the first and the second groups were established by selection for high and low total egg weight laid by female during the first 10 weeks of laying **($HTEW_{10}$&$LTEW_{10}$)** and the third was maintained as a randombred control line **(RBC)** to study the direct response for total egg weight laid by female during the first 10 weeks of egg production. The results obtained can be summarized as follow:

1- TEW_{10} increased highly significantly (P<0.01) in the selected line ($HTEW_{10}$) from 469.02g at generation zero to 500.12g at the third generation of selection and decreased highly significantly (P<0.01) in the selected line ($LTEW_{10}$) from 469.02g at generation zero to 431.25g at the third generation of selection. TEW_{10} in the control line fluctuated randomly from generation to another, however, there was no significant increase and/or decrease between the mean of generation zero (469.02g) and that of the third generation (473.58g).

2- After three generations of selection for TEW_{10}, the females of selected line ($HTEW_{10}$) produced more TEW_{10} by 5.60% and the females of selected line ($LTEW_{10}$) produced less TEW_{10} by 9.82% compared with the females of control line.

3- Coefficient of variation in the selected trait TEW_{10} decreased from 29.62% at generation zero to 25.47% at the third generation among $HTEW_{10}$ and decreased from 28.25% at generation zero to 24.64% at the third generation among $LTEW_{10}$. Estimates obtained in the RBC line were 20.65 and 19.02%.

4- The effect of generation and line on (TEW_{10}) was highly significant ($P<0.01$), while the effect of the sire and the dam on this trait was not significant.

5- No significant differences were found between the actual and the expected selection differentials through the three generations of selection, however, the actual selection differential agree well with the expected in the $HTEW_{10}$ and $LTEW_{10}$ lines, where it was averaged 20.37, 19.00g/ generation among $HTEW_{10}$ and -16.63, -16.22g/generation among $LTEW_{10}$, while significant differences ($P<0.05$) were found between actual and expected selection differentials from generation zero to generation three in the control line. Unwittingly there was some selection in the control line for TEW_{10}, however this selection was generally negative. On an average the actual and the expected selection differentials were -15.85 and -15.17g /generation in the control line. The ratio of actual to expected selection differentials was greater than unity, suggesting that natural selection may had a positive effect on selection for TEW_{10}.

6- The actual response to selection in the ($HTEW_{10}$ and $LTEW_{10}$) lines was irregular through the three generations of selection averaging 11.30 and -8.00g/generation among the two divergent selected lines. The cumulative response to selection in the ($HTEW_{10}$ and $LTEW_{10}$) lines were 33.89 and -24.01g/generation among the two divergent selected lines after the third generation of selection.

7- Heritability of TEW_{10} were estimated by different methods:

a- The dam variance component (h^2_D) were found to be 0.35, 0.47, 0.52 for the first, second and third generation.

b- The sire variance component (h^2_S) were 0.18, 0.25, 0.11 for the first, second and the third generation.

c- The sire+dam variance components (h^2_{S+D}) were intermediate between the two previous estimates, it was 0.25, 0.35, 0.59 for the first, second and the third generation.

d- The realized heritability were found to be 0.58, 0.58, 0.55 for the first, second and the third generation.

INTRODUCTION

The main goal from selection experiments on egg production is to increase the reproductive performance, where the number of birds reproduced from each hen will be increased (Bahie El-Deen et al., 1998). A commonly occurring problem in all avian species studied is the relatively poor reproductive performance of birds selected for increased growth rate. This poor performance is usually reflected as a decrease in total egg production as well as an increase in the production of unsitable eggs for setting such as: soft-shelled membrane and double-yolked eggs (Nestor and Bacon, 1982 and Strong et al., 1978). Research work in poultry is often handicapped by limits in budget, time and space. Some of these problems might be alleviated by using Japanese quail as a pilot animal for breeding research (Wilson et al., 1961). However, its comparability with the domestic fowl must be better understood if the full potential of the quail is to be realized .

Quail is the smallest avian species raised for meat and egg production. (Panda and Singh, 1990) and it has also assumed world wide importance as a laboratory animal (Baumgartner, 1990). Distinct characteristics include rapid growth, enabling quail to be market for consumption at 5-6 weeks of age, early sexual maturity resulting in a short generation interval, high rate of lay and much lower feed and space requirements than the domestic fowl. Furthermore, quail could be considered a good and economical source for animal protein because its meat contains 22.8% protein in breast and 19.6% in the fumier. Therefore, countries having shortage in animal protein, such as in Egypt can depend on quail to compensate a part of this shortage .

The present study was undertaken to study the effect of divergent selection on the total egg weight laid by female during the first 10 weeks of egg production in Japanese quail.

MATERIALS AND METHODS

Data of the present study were collected from May 2006 until December 2007 on the flock of Japanese quail (*Coturnix coturnix japonica*) maintained by the Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt,

Breeding plan and management:

A total number of 330 birds (110 males and 220 females) at 6 weeks of age were taken at random from the flock under consideration as the parents of the present study. The mating system in the base population was in a ratio of one male to two females avoiding full and half-sib matings. The birds were randomly assigned to three mating groups, the first and the second groups were established by selection for high and low total egg weight laid by female during the first 10 weeks of laying ($HTEW_{10}$&$LTEW_{10}$). The third group was maintained as a randombred control line (RBC) to study the direct response for total egg weight laid by female during the first 10 weeks of egg production. Higher and lower total egg weight laid from each female among the first 10 weeks of laying ($HTEW_{10}$ & $LTEW_{10}$) within each family were selected according to their deviation from the family mean.

Hatched eggs were collected when females were 10 to 12 weeks of age, marked and incubated for 15 days. After incubation, the eggs were transferred to the hatcher for 3 days. Immediately after hatch individual birds were permanently identified by wing-bande and placed in quail battery brooders. All birds were sexed according to plumage color and remained for 4 weeks period then moved to individual laying cages and stud matings started about two weeks later.

The selected breeders were housed in breeding cages with the dimensions of 20x20x25cm (one male and two females per cage) with sloping floor for collecting the eggs. Eggs were collected twice daily in a pedigree system for each family.

All birds were housed in the same room in order to keep temperature, humidity, light intensity and other variables uniform as possible. However, environment and management practices were at conventional levels through the whole study. At 5 weeks of age, males were separated from the females and at 6 weeks of age, randomly assigned to the three mating groups. The eggs of each female were isolated in a separate plastic net inside the hatcher marked and incubated for 15 days and 3 days later in the hatcher.

Feed and water were provided *ad-libitum*. The experimental diet contained 28% protein and 2920 k cal-ME/Kg until 2 weeks of age and 25% protein with 2850 k cal-ME/Kg during 3-6 weeks of age, then changed to a ration contained 20% protein with 2820 k cal-ME/Kg during the laying period. The same diets were provided to birds on the selection process across various generations. The minerals and vitamins were adequately supplied to cover the requirements according to N R C. (1994) throughout the experimental duration. Temperature started with 37.5°C for the first week after hatching, then decreased 2-3°C weekly to 26-28°C at the fourth week of age till the end of brooding period. No vaccination and/or beak trimming programs were carried out to the breeding stocks.

Statistical analysis :

Statistical analysis were conducted using the General Linear Models (GLM) procedure of base SAS software (SAS Institute, 1988). Differences between each two means were done according to Duncan's Multiple Range Test. Data of the selected trait (TEW_{10}) were analyzed using mixed model (Harvey, 1987, model type 5) including each of generation and line as a fixed effects and sire and dam within sire as a random effects.

The following model was adopted:

$Y_{ijklm} = \mu + G_i + L_j + S_k + D_{lk} + e_{ijklm}$.

where:

Y_{ijklm} = the observation of ijklm th bird.

μ = the overall mean, common element to all observations.

G_i = the fixed effect of i^{th} generation.

L_j = the fixed effect of j^{th} line.

S_k = the random effect of k^{th} sire.

D_{lk} = the random effect of l^{th} dam nested within a random effect of k^{th} sire.

e_{ijklm} = the random error term.

Henderson Method 3 (Henderson, 1953) was utilized to estimate the genetic variance components for the different traits studied.

RESULTS AND DISCUSSION

Direct response:

The actual means of TEW_{10} among three generations of selection in the selected and control lines are presented in (Table. 1). TEW_{10} highly significantly ($P<0.01$) increased in the selected line ($HTEW_{10}$) from 469.02g at generation zero to 500.12g at the third generation of selection and highly significantly ($P<0.01$) decrease occurred in the selected line ($LTEW_{10}$) from 469.02g at generation zero to 431.25g at the third generation of selection (Table. 1). On the other hand, TEW_{10} in the control line fluctuated randomly from generation to another, however, there was no significant increase and/or decrease between the mean of generation zero (469.02g) and that of the third generation (473.58g). However, after three generations of selection for TEW_{10}, the females of selected line ($HTEW_{10}$) produced more TEW_{10} by 5.60% , while the females of selected line ($LTEW_{10}$) produced less TEW_{10} by 9.82% compared with the females of control line. The same trend was reported by Aboul-Hassan (2001) and Abdel- Tawab (2006) when they selected Japanese quail for increased TEN_{10} and EW_{10}.

As TEW_{10} increased in the $HTEW_{10}$ line, the C.V.% of this trait decreased from 29.62% at generation zero to 25.47% at the third generation and as TEW_{10} decreased in the $LTEW_{10}$ line, the C.V.% of this trait decreased from 29.62% at generation zero to 24.64% at the third generation, respectively (Table, 1). The corresponding estimates obtained in the RBC line were 29.62 and 18.48%, respectively. The change in C.V% from generation zero to generation three in the $HTEW_{10}$ and $LTEW_{10}$ lines did not show any significant trend , while it was significant in RBC line. The same trend was reported by Aboul-Hassan (2001) and Abdel-Tawab (2006) when they selected Japanese quail for increased TEN_{10} and EW_{10}.

Table (1): Actual means, standard deviations (S.D) and coefficients of variation (C.V%) for TEW_{10} (g) in the selected and control lines among generations of selection.

Line / **Gen.**	$HTEW_{10}$ Mean±S.D	C.V%	$LTEW_{10}$ Mean±S.D	C.V%	RBC Mean ± S.D	C.V%
0	469.02±15.18	29.62	469.02±15.18	29.62	469.02±15.18	29.62
1	489.65±13.62	28.85	451.25±16.25	26.85	475.25±13.48	20.54
2	495.21±11.60	27.39	445.32±18.54	26.47	470.94±17.89	19.02
3	500.12±10.49	25.47	431.25±20.15	24.64	473.58±14.98	18.48
Average	**488.50±12.72**	**27.83**	**449.21±17.51**	**26.90**	**463.20±15.38**	**21.92**

HTEW10 =High total egg weight during the first 10 weeks of laying
LTEW10 =Low total egg weight during the first 10 weeks of laying
RBC =Randombred control line

The least-square means, their standard errors and test of significance for factors affecting high and low TEW_{10} are presented in (Tables 2 and 3). Results obtained in Table (2) indicated that among $HTEW_{10}$ line, total egg weight after 10 weeks of onset increased significantly (P<0.05) from 468.21g at the first generation to 490.69g at the third generation. The same trend was noticed for line effect (Table, 2).

For $LTEW_{10}$, the average total egg weights produced by female among the first 10 weeks of egg production was decreased significantly (P<0.05) from 465.21g at the first generation to 447.01g at the third generation. The same trend was noticed for line effect (Table 2).

Table (2): Least-square means and standard errors (S.E) of TEW_{10}(g) in the selected and control lines among generations of selection.

	$HTEW_{10}$		$LTEW_{10}$	
Items	**No.**	**Mean ± S.E**	**No.**	**Mean ± S.E**
Generation:				
1st	122	468.21±3.55^a	75	465.21±5.24^a
2nd	120	485.54±4.36^b	70	459.65±7.25^b
3rd	106	499.69±3.84^c	68	437.01±9.15^c
Line:				
$HTEW_{10}$	348	495.12±5.35^a	---	------------------
$LTEW_{10}$	---	------------------	213	449.32±4.36^a
RBC	204	470.89±4.25^b	204	475.21±7.45^b

a,b,c = Means in the same column with different superscripts differ significantly (P<0.01).

The least-square means for factors affecting both high and low TEW_{10} varied significantly (P<0.01) among generations and lines, while the sire and the dam had non-significant effect on this trait (Table 3). The same trend was reported by Aboul-Hassan (2001) and Abdel-Tawab (2006) when they selected Japanese quail for increased TEN_{10} and EW_{10}.

The dam variance component in both high and low TEW_{10} were higher than sire components of variance and consequently percentage of variations due to dam effect were larger than those due to the sire effects (0.64, 0.50 and 21.05, 17.24% vs 0.28, 0.24 and 9.21. 8.28%) as shown in

Table (4). These results were in agreement with those obtained by Aboul-Hassan (2001) and Abdel-Tawab (2006) when they selected Japanese quail for increased TEN_{10} and EW_{10}.

Table (3): F- ratios and test of significance for factors affecting TEW_{10}.

	$HTEW_{10}$		$LTEW_{10}$	
S.O.V.	**d.f**	**F-ratio**	**d.f**	**F-ratio**
Gen.	2	47.32**	2	53.87**
Line	1	67.54**	1	85.65**
Sire: G.	155	2.54	78	2.54
Dam: (S) : (G)	216	3.47	165	3.54
Remainder	1251		610	

Table (4): Variance components (δ^2) and percentage of variation (V%) estimated for random effects on TEW_{10}.

Var. comp. LLLLL	**Sire**		**Dam : Sire**		**Remainder**	
	δ^2s	V%*	δ^2D:s	V%*	δ^2e	V%*
$HTEW_{10}$	0.28	9.21	0.64	21.05	2.12	69.74
$LTEW_{10}$	0.24	8.28	0.50	17.24	2.16	74.48
RBC	0.18	6.72	0.48	17.91	2.02	75.37

* V% = Percentage of variation.

4.2.1. Selection differential :

Selection differential calculated as expected and actual as well as the ratio between the actual and expected selection differentials (Actual/Expected) are presented in (Tables 5&6) for high and low lines selected for TEW_{10}. The actual selection differential agree well with the expected in the $HTEW_{10}$ and $LTEW_{10}$ lines. However, no significant differences were found between the expected and the actual selection differentials from generation zero to generation three. This means that the distribution of TEW_{10} confirm with the properties of a normal distribution closely enough to allow fairly accurate prediction. The same trend was reported by Aboul-Hassan (2001) and Abdel-Tawab (2006) when they selected Japanese quail for increased TEN_{10} and EW_{10}.

Table (5): Actual and expected selection differentials (g) and the ratio of actual to expected selection differentials for $HTEW_{10}$.

Gen.	Actual	Expected	Act. / Exp.
0	**21.95±0.65**	**21.01±0.55**	**1.04**
1	**21.21±0.78**	**19.60±0.61**	**1.08**
2	**20.07±0.88**	**18.39±0.57**	**1.09**
3	**18.25±0.92**	**17.01±0.45**	**1.07**
Average	20.37±0.68	19.00±0.85	1.07

Table (6): Actual and expected selection differentials (g) and the ratio of actual to expected selection differentials for $LTEW_{10}$.

Gen.	Actual	Expected	Act. / Exp.
0	**-18.50±0.25**	**-18.01±0.54**	**-1.03**
1	**-16.85±0.35**	**-16.02±0.67**	**-1.05**
2	**-15.32±0.54**	**-15.21±0.81**	**-1.01**
3	**-15.85±0.68**	**-15.65±0.98**	**-1.01**
Average	-16.63±0.43	-16.22±0.68	-1.03

Significant differences ($P<0.05$) were found between actual and expected selection differentials from generation zero to generation three in the control line (Tables 5&6). Unwittingly there was some selection in the control line for high and low TEW_{10}, however this selection was generally negative. This might be explained by deviations in the random choice. On an average the expected and actual selection differentials were -15.85 and -15.17 g in the control line. The ratio of actual to expected selection differentials was greater than unity, which suggests that natural selection may had a positive effect on selection for TEW_{10}.

Cumulative (expected and actual) selection differentials are presented in (Table 7). The values for cumulative selection differentials were 26.52 and 28.36g at generation zero among the ($HTEW_{10}$) line increased to 32.25 and 33.92g at generation three. The corresponding values for ($LTEW_{10}$) line were -22.65, and -23.21g at generation zero increased to -28.25 and -32.01g at generation three, respectively. The cumulative actual selection differential takes into account the effects of natural selection expressed through fertility of selected phenotypes (Falconer, 1960).

Table (7): Cumulative (expected and actual) selection differentials (g) for TEW_{10}.

Line / Generation	Cumulative (Expected)		Cumulative (Actual)	
	$HTEW_{10}$	**$LTEW_{10}$**	**$HTEW_{10}$**	**$LTEW_{10}$**
0	26.52	-22.65	28.36	-23.21
1	29.19	-23.81	30.54	-29.02
2	30.95	-24.25	32.95	-30.24
3	32.25	-28.25	33.92	-32.01
Average	**29.73**	**-24.74**	**31.44**	**-28.62**

Selection response :

The actual and cumulative selection response are presented in (Table 8). The actual response to selection in the ($HTEW_{10}$ and $LTEW_{10}$) lines was decreased from generation to another averaging 11.30 and -

8.00g/generation among the two divergent selected lines. The estimated response to selection after the first generation of selection was 12.24g, then it decreased gradually as the selection continued to 11.59 and 10.06g after the second and the third generation of selection among $HTEW_{10}$ line and it was -9.54g after the first generation of selection , then it decreased gradually as the selection continued to -7.95 and -6.52g after the second and the third generation of selection among $LTEW_{10}$, respectively. This decrease of the selection response had been observed in many selection experiments reported in the literature. The cumulative response to selection in the ($HTEW_{10}$ and $LTEW_{10}$) lines were 33.89 and -24.01g among the two divergent selected lines after the third generation of selection. However, Abdel-Tawab (2006) reported that the actual response to selection for HEW was 1.22g after the first generation of selection and fluctuated to be 0.68g after the third generation of selection.

Falconer (1954) have shown that the irregularity in response to selection might have been due to many causes of genetical or environmental nature. Differences in natural selection differential, fertility and/or genetic-environment interaction on BW might be cause such irregularity in selection response specially in such small numbers of generations as it was the case in the present study.

The actual response to selection observed in the RBC line was positive and fluctuated between generations. It decreased from 5.36g after the first generation to 2.12g after the second generation and increased to 3.87g after the third generation of selection with an average of 3.78g/generation. (Table, 8).

Table (8):Actual and cumulative selection responses (g) for TEW_{10} .

Line	Actual		Cumulative	
Generation	**$HTEW_{10}$**	**$LTEW_{10}$**	**$HTEW_{10}$**	**$LTEW_{10}$**
0-1	12.24±0.32	-9.54± 0.35	12.24	-9.54
1-2	11.59±0.63	-7.95±0.68	23.83	-17.49
2-3	10.06±0.95	-6.52±0.92	33.89	-24.01
Average	**11.30± 0.42**	**-8.00±0.42**	-----	-----

Heritability estimates:

1.Components of variance:

Heritability estimates for TEW_{10} among the high line calculated from components of variance i.e. sire (paternal half-sibs), dam within sire (maternal half-sibs) and sire plus dam (full-sibs) are presented in Table (9). However, the dam component is expected to be larger in magnitude by the variances due to the dominance deviations and maternal effects. Heritabilities computed from the sire component (h^2_S) ranged between 0.18 and 0.29 among the three generations of selection and that computed from the dam components (h^2_D) are generally higher than those computed from the sire components, it ranged between 0.41 and 0.57. This may be due to the large dam variance components obtained and the non-genetic effects, primarily dominance and maternal, normally result in the h^2_D estimates being considerably larger than h^2_S estimates. While, heritabilities computed from full-sib components (h^2_{S+D}) ranged between moderate and high in magnitude (0.27- 0.46). These result were in agreement with those reported by **Abdel-Tawab (2006),** where the estimates for h^2_S, h^2_D and h^2_{S+D} ranged between 0.14-0.22, 0.46-0.58 and 0.30-0.66, respectively when selection was applied for increased EW_{10}. **Aboul-Hassan (2001)** estimated h^2_S , h^2_D and h^2_{S+D} as 0.13, 0.20 and 0.15, respectively when selection was applied for $HTEN_{10}$.

Table (9):Heritability estimates computed from sire, dam, sire plus dam components of variance as well as realized heritability for TEW_{10}.

Heritability Generation	Sires h^2_S ±S.E	Dams: Sires $h^2_{D:S}$ ±S.E	Full-sibs h^2_{S+D} ±S.E	Realized h^2±S.E
1	0.18±0.12	0.41±0.11	0.27±0.19	0.58±0.12
2	0.29±0.18	0.48±0.15	0.37±0.12	0.58±0.10
3	0.19±0.11	0.57±0.10	0.46±0.17	0.55±0.16

2. Realized heritability:

The realized heritability estimated for TEW_{10} among the high line as the ratio between response to selection and selection differential (R/S) are presented per generation in (Table 9). The estimates of the realized heritability for TEW_{10} decreased from 0.58 at the first generation to 0.55 at the third generation. The present estimates were higher than that reported in the literature for the same trait. However, Aboul-Hassan (2001) reported a range of estimates (0.26-0.30) for realized heritability of TEN_{10}. Furthermore, Abdel-Tawab (2006) reported that realized heritabilities ranged from 0.24 to 0.47 over 3 generations of selection for increased EW_{10}.

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الإنتخاب المتفرع لإنتاج البيض فى السمان اليابانى – الأستجابة المباشرة

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الملخص العربي

أجريت هذه الدراسة في مزرعة السمان البحثية التابعة لقسم الإنتاج الحيواني - كلية الزراعة – جامعة الأزهر بمدينة نصر - القاهرة في الفترة من مايو ٢٠٠٦ إلى ديسمبر٢٠٠٧م حيث تم إجراء تجربة إنتخاب متفرع لصفة وزن البيض الكلى المنتج خلال الـ١٠ أسابيع الأولى من الإنتاج فى السمان اليابانى لمدة ثلاثة أجيال وقد قسمت الطيور عشوائيا إلى ٣ مجاميع تزاوجية:

المجموعة الأولى والثانية للإنتخاب لصفة وزن البيض الكلى العالى والمنخفض المنتج خلال الـ١٠ أسابيع الأولى من الإنتاج ($HTEW_{10}$ & $LTEW_{10}$).

المجموعة الثالثة لتكوين خط غير منتخب معاصر ومقارن للخط المنتخب (RBC).

تهدف هذه الدراسة إلى قياس الإستجابة المباشرة للإنتخاب المتفرع لصفة وزن البيض الكلى المنتج خلال الـ١٠ أسابيع الأولى من الإنتاج .

وقد أوضحت الدراسة النتائج الآتية :

١- ازداد متوسط وزن البيض الكلى المنتج خلال الـ ١٠ أسابيع الأولى من الإنتاج من ٤٦٩,٠٢ جم عند الجيل رقم صفر إلى ٥٠٠,١٢ جم عند الجيل الثالث من الإنتخاب فى الخط المنتخب لوزن البيض العالى بينما إنخفض من ٤٦٩,٠٢ جم عند الجيل رقم صفر إلى ٤٣١,٢٥ جم عند الجيل الثالث فى الخط المنتخب لوزن البيض المنخفض ولم يلاحظ وجود أى زيادة أو نقص فى متوسط وزن البيض الكلى المنتج خلال الـ ١٠ أسابيع الأولى من الإنتاج من إناث الخط المقارن حيث كان ٤٦٩,٠٢ جم فى الجيل الأول و٤٧٣,٥٨ جم فى الجيل الثالث من الإنتخاب.

٢ - بعد ثلاث أجيال من الإنتخاب لهذه الصفة أنتجت إناث الخط المنتخب لوزن البيض العالى وزنا أعلى للبيض بمقدار ٥,٦٠% بينما أنتجت إناث الخط المنتخب لوزن البيض المنخفض وزنا أقل للبيض بمقدار ٩,٨٢% بالمقارنة بوزن البيض المنتج من إناث الخط المقارن.

٣- إنخفض معامل الإختلاف لصفة متوسط وزن البيض الكلى المنتج خلال الـ١٠أسابيع الأولى من الإنتاج من ٢٩,٦٢% فى الجيل رقم صفر إلى ٢٥,٤٧% فى الجيل الثالث من الإنتخاب فى الخط المنتخب لوزن البيض الكلى العالى كما إنخفض فى الخط المنتخب لوزن البيض الكلى المنخفض من ٢٨,٢٥% إلى ٢٤,٦٤% كما إنخفضت قيم معامل الإختلاف فى الخط المقارن من ٢٠,٦٥% فى الجيل رقم صفر إلى ١٩,٠٢% فى الجيل الثالث.

٤- كان تأثير كل من الجيل والخط على صفة متوسط وزن البيض المنتج خلال الـ ١٠ أسابيع الأولى من الإنتاج عالى المعنوية بينما لم يكن للآباء والأمهات تاثير معنوى على هذه

الصفة .

٥- لم يكن هناك اختلافات معنوية بين قيم الفارق الإنتخابى الفعلى والمتوقع خلال الأجيال الثلاثة من الإنتخاب حيث إتفقت قيم الفارق الإنتخابى الفعلى والمتوقع فى كلا الخطين المنتخبين لوزن البيض الكلى حيث كان متوسط هذه القيم ٢٠,٣٧ و ١٩,٠٠ جم لكل جيل فى الخط المنتخب لوزن البيض الكلى العالى بينما كان متوسط هذه القيم – ١٦,٦٣ و – ١٦,٢٢ جم لكل جيل فى الخط المنتخب لوزن البيض الكلى المنخفض بينما لوحظ وجود إختلافات معنوية بين الفارق الإنتخابى الفعلى والمتوقع من الجيل رقم صفر إلى الجيل الثالث فى الخط المقارن حيث كان متوسط قيم الفارق الإنتخابى الفعلى والمتوقع – ١٥,٨٥ و- ١٥,١٧ جم لكل جيل كما وجد أيضا أن نسبة الفارق الإنتخابى الفعلى إلى المتوقع كانت أكبر من الوحدة وهذا يعنى أن الإنتخاب الطبيعى يمكن أن يكون له تأثير إيجابى على الإنتخاب لهذه الصفة.

٦- كانت الإستجابة الواقعية لفعل الإنتخاب منتظمة فى كلا الخطين المنتخبين لوزن البيض الكلى العالى والمنخفض حيث كان متوسط قيم الإستجابة الواقعية ١١,٣٠ و - ٨,٠٠ جم فى الجيل فى كلا الخطين المنتخبين كما كانت الإستجابة المتراكمة لفعل الإنتخاب بعد ثلاثة أجيال من الإنتخاب لهذه الصفة ٣٣,٨٩ و -٢٤,٠١ جم فى كلا الخطين المنتخبين لوزن البيض الكلى العالى والمنخفض.

٧- تم قياس المكافىء الوراثى بعده طرق هى :

أ- مكون التباين الوراثى الأمى وكانت القيم المقاسة للمكافىء الوراثى خلال الأجيال الثلاثة هى ٠,٣٥ و ٠,٤٧ و ٠,٥٢ .

ب- مكون التباين الوراثى الأبوى وكانت القيم المقاسة بهذه الطريقة أقل من تلك المقاسة بالطريقة السابقة خلال الأجيال الثلاثة وكانت ٠,١٨ و ٠,٢٥ و ٠,١١ .

جـ- مكون التباين الوراثى الأبوى والأمى معا وكانت القيم المقاسة وسط بين تلك القيم المقاسة بالطريقتين السابقتين وكانت ٠,٢٥ و ٠,٣٥ و ٠,٥٩ .

د- كانت قيم المكافىء الوراثى المحقق المقاسة خلال الأجيال الثلاثة هى ٠,٢٩ و ٠,٢٩ و ٠,٢٦ .