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EFFECTS OF SELECTION FOR FAST GROWTH RATE ON JAPANESE QUAIL LAYING PERFORMANCE AND FITNESS TRAITS

B. Y. F. Mahmoud[1], D. A. M. Semida[1], E. A. El-Full[1] and A. M. Emam[1, 2]

[1]Poult.Prod.Dep., Fac. of Agric, Fayoum Uni., 63514 Fayoum, Egypt.

[2] **Corresponding author:** Ahmed M Emam Email: ame04@fayoum.edu.eg

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ABSTRACT: This work aimed to study the effects of selection for fast growth rate on some laying and fitness performance in Japanese quail using 1157 females (706 for the selected line and 451 for the control line). The most important results obtained as follows: Generation significantly affected all egg studied traits indicating that the 4th generation (G_4) had the earliest age at first egg (AFE) and age at the first ten eggs (AGE_{10}) accompanied by the heaviest body weight at first egg (BW_{AFE}**)** and desirably had lower days needed to produce the first ten eggs (DN_{10}) and laid heavier average egg weight (AEW_{FM}) (48.98 day, 60.87 day, 260.77 g, 13.12 day and 11.88 g respectively) and had higher number of eggs (EN_{FM}), heavier egg mass for the first month of production (EM_{FM}), and favorably lower pause duration length (PDL_{FM}) than other generations being of 24.53 egg, 291.32 g and 1.76 day, respectively. Moreover, the G_4 had higher fertility (88.20%) and hatchability (85.42%) associated with preferably lower early and late embryonic mortality% than other generations.

The selected line attained AFE at earlier age (50.63 day) with heavier BW_{AFE} (260.59g) and lower DN_{10} (14.06 day) and AGE_{10} (64.44 day), laid more EN_{FM} (22.63egg), higher EM_{FM} (263.67g), earlier age after first month of production (AGE_{FM}, 80.63 day), larger clutch size (CS_{FM}, 5.20) and shorter PDL_{FM} (1.89 day) and had preferably higher fertility (80.69%), hatchability (74.14%) but undesirably higher early embryonic mortality% (2.68%) than the control line.

There were favorable negative correlations between growth rate during 1-21 days of age (GR_{1-21}.) And each of AFE, DN_{10}, AGE_{10}, PDL_{FM} and AGE_{FM} and had preferably positive rg's with each of BW_{AFE}, EN_{FM}, EM_{FM}, clutch number for the first month of production and CS_{FM}, it seemed these traits can be indirectly improved through the selection for fast GR_{1-21}.

Key words: Japanese quail, fast growth rate, egg production, fertility and genetic gain.

INTRODUCTION

Either short or long term selection programs on Japanese quail have focused on body weight (BW) enhancement at fixed ages mostly at 28 or 35 days age or early egg production (Khaldari *et al.*, 2010, Narinc and Aksoy, 2012 and Taskin *et al.,* 2017). Unfortunately, increasing body weight has been accompanied by negative complications such as incidence of excessive fatness which is unproductive moreover, the reproductive potential of quail is adversely affected (Havenstein *et al.,* 1994, Nicholson, 1998 and Decuypere *et al.*, 2003).

The reduction in different reproduction traits, such as egg production, fertility, and hatchability due to selection for body weight which has a positive effect on egg weight increase (Anthony *et al*., 1996 and Nestor *et al.*, 2008). There were correlations between both embryo development and hatchability with hatching egg weight (Rocha *et al.,* 2008 and Grzegrzółka and Gruszczyńska, 2019). It is well known that genetic background of lines affected the differences of these traits (Brah *et al.*, 2001). The relationships between chronological age, body weight and sexual maturity are complicated (Oruwari and Brody, 1988), selection for growth was very effective on increasing overall body weight at a specific age, it has altered some physiological relationships that are critical with respect to optimizing sexual development in terms of age. The selection program effects not only change growth pattern, age at first egg, reproductive and fitness traits, but also will be resulted in negative correlation between the high body weight and reproductive traits such as fertility and egg traits (Sadeghi *et al.*, 2013). Further breeding should consider not only how to increase production but also how to alleviate correlated side effects by extending or changing selection goals for obvious economic reasons and also because of the unacceptability of some correlated responses to an increasing number of breeder. Since, there were little or no information could be found in literature on the studied GR_{1-21} trait and its relationships with egg and fitness performance of Japanese quail therefore, this work aimed to study the consequences of selection for fast growth rate on some laying performance and fitness traits in Japanese quail.

MATERIALS AND METHODS

This work was carried out at the farm of the Poultry Research Center, Faculty of Agriculture, Fayoum University. A selection experiment for fast growth rate during the period from one to 21 days of age according to the aggregate breeding values of the selection criterion was continued for four consecutive generations using a total number of 6998 birds including 1157 Japanese quail females (706 females for the selected line and 451 for the control line) which were recorded egg production traits for 30 days after first eggs as shown in Table 1.

The selected breeders were housed (two females were randomly assigned to each male) in breeding cages. Mating of close relatives were avoided to decrease the rate of inbreeding depression. Eggs were daily collected in a pedigree system for each family depending on the shell color and patterns of each female when ages of females were 11–14 weeks of age. According to NRC (1994), from 35 days of age to the end of the experiment, a breeder diet containing 20% crude protein, 2900 K Cal ME, 2.25% calcium and 0.43% available phosphorous was supplied. The light system was16 hours of light per day through out production period. Birds were kept under the same managerial hygienic and environmental conditions.

Studied Traits:

Egg production-related traits:

The studied or calculated traits were individually recorded for each female during the first month of production:

1. Age at first egg (AFE, day).
2. Body weight at first egg (BW_{AFE}, g).
3. Days needed to produce the first ten eggs (DN_{10}, day).
4. Age at the first ten eggs (AGE_{10}, day).
5. Number of eggs produced in the first month of production (EN_{FM}, egg).
6. Egg mass for the first month (EM_{FM}, g).
7. Average egg weight (AEW_{FM}, g) in the first month of production.
8. Clutch number for the first month (CN_{FM}, as a number of clutches /hen).
9. Clutch size (CS_{FM}, as an average of clutch eggs /hen).
10. Pause duration length (PDL_{FM}, day) in days.
11. Age after first month of production (AGE_{FM}, day).

Fitness traits:

Fertility%: = (Number of fertile eggs/Number of total eggs set) x100.

Hatchability%: = (Number of hatched chicks / Number of fertile eggs) x 100

Embryonic mortality traits:

After hatching, the remaining eggs were cracked to account for dead embryos at an early embryonic stage and at a late embryonic stage as a percentage of the total number of eggs set for each female (early embryonic mortality% and late embryonic mortality%) in all generations. Early embryonic mortality was classified as embryo died before nine days of development (before black pigmentation appearance) however, late embryonic mortality was classified as embryo died after nine days of development.

Statistical analyses

Egg production and fitness traits were analyzed by PROC MIXED (SAS, 2011) to calculate the generation and line specific means by the following model:

$Y_{ijkl} = \mu + a_i + G_j + L_k + g_j l_k + e_{ijkl}$

Where:

Y_{ijkl}: is the observation for a trait μ: is the overall mean, a: is the random additive genetic effect of the i^{th} animal, G: the effect of j^{th} generation , L: the effect of k^{th} line,

$g_j l_k$: : the effect of j^{th} generation with the k^{th} line and e_{ijkl}: is the random error term; the random variable was the birds within line. Means of generation were compared using multiple range test (Duncan, 1955).

Genetic Parameters:

Both univariate and bivariate linear animal models used to estimate heritabilities (h^2) of studied traits and correlations (REML procedures by WOMBAT program software, Meyer, 2007) as follows:

The univariate model to estimate direct h^2 was:

$Y = Xb + Za + e$

The bivariate model to estimate correlations between selection criterion trait and egg production-related traits was:

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} x_1 & 0 \\ 0 & x_2 \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} + \begin{bmatrix} z_1 & 0 \\ 0 & z_2 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \end{bmatrix}$$

Where: for trait i (i=1, 2), y_i=vector of observations, b_i= vector of fixed effects (i.e., generation and line, a_i=vector of random direct genetic effects, e_i=vector of random residual effects, and X_i and Z_i are incidence matrices relating the observations to the respective fixed and direct genetic effects.

Genetic gain:

Genetic gain evaluation depending on breeding values for the egg production-related traits through a mixed model method (Henderson, 1973), by determining the difference between the averages of the breeding values of the first and the last generation within each line, separately.

RESULTS AND DISCUSSION

Performance of egg production-related traits:

Generation effect on egg production-related traits:

Selection generation significantly affected all egg production- related traits studied indicating that the 4th generation of selection had the earliest AFE and AGE_{10} (47.98 and 60.87 days) whereas the latest estimates for AFE (54.66 days) was obtained by the 3rd generation whereas other generations were attained AGE_{10} at later ages ranging from 66.29 to 67.78 days (Table 2). Elkomy *et al.* (2019) reported lower AFE ranging from 39.34 to 48.45 days compared with this study.

Significant differences among generations for AFE were reported by Farrag (2011), Okenyi *et al.* (2013), Emam (2015), Meabed (2015) and Mahmoud *et al.* (2014 and 2016). In the contrary, Naser and Abbas (2012) reported insignificant generation effect on AFE. Quail in the 4th generation of selection showed the heaviest BW_{AFE} (260.77g) and desirably had lower DN_{10} (13.12 days) and laid heavier AEW (11.88g) whereas the 2nd generation had lighter AWE of 11.34g than other generations. Elkomy *et al.* (2019) reported that heavier egg weights (13.26:14.52,g) than those of this study.

Both Okenyi *et al*. (2013) and Mahmoud *et al.* (2014) reported significant differences among generations for BW_{AFE}. There were significant generation fluctuations in DN_{10} as reported by Mahmoud *et al.* (2014) and Emam (2015). In the contrary, Meabed (2015) found that there was insignificant difference due to generation for DN_{10}.

Line effect on egg production-related traits:

The selected line attained AFE at earlier age with heavier BW_{AFE} and lower DN_{10} and AGE_{10} than the control line whereas, the control line had insignificantly heavier AEW_{FM} than selected line (Table 2). Similarly, line had significant effect on AFE as reported by Farrag (2011), Narendra Nath *et al.* (2011), Sadeghi *et al.* (2013), Mahmoud *et al*. (2014), Emam (2015), Meabed (2015) and Farahat *et al.* (2018). However, Karabağ *et al.* (2010) and Alkan *et al.* (2013) reported insignificant line effect on AFE. Abou Khadiga *et al.(*2016) found significant superiority of the selected line for AFE (-3.03) and BW_{AFE} (+10.38). Emam (2015) reported that selection for high BW_{21} resulted in desirable decrease in DN_{10} of -11.71 days for the selected line fed 24% CP diet quails vs. 13.28 days for the control fed 24% CP diet quails. There were significant differences among lines for DN_{10} favoring the selected line for selection index (AFE, BW_{AFE} and DN_{10}) and trends of selection changes were towards early maturity and shorter DN_{10} (Mahmoud *et al.*, 2014 , Abou Khadiga *et al.*, 2016 and Farahat *et al.*, 2018). Regardless of generation number, averages for AEW were higher in selected lines for high body weight than those in the control lines (Karabağ *et al.*, 2010, Farrag, 2011 and Narendra Nath *et al.*, 2011).

Generation effect on egg production traits:

All egg production traits studied significantly affected by both selection generation and line effects (Table 3). The 4th generation had higher EN_{FM}, heavier EM_{FM}, earlier AGE_{10} and lower PDL_{FM}

(24.53egg, 291.32g, 77.98 and 1.76 days, respectively) than other generations however, the 2nd generation had more CN_{FM} with shorter CS_{FM} as compared to other generations (6.07 clutch and 3.68egg) and the tallest PDL_{FM} was shown for the 1st generation. Similarly, generation significantly affected EN and EM (Naser and Abbas, 2012 and Emam, 2015). Estimated EN from the results of Elkomy *et al.* (2019) were ranged from 19.83 to 23.93 eggs per month and agreed with this study.

There were fluctuations across generations in EM's during different periods up to 70 days of egg production due to significant generation effects reported by Mahmoud *et al.* (2014 and 2016). On the other hand, Meabed (2015) reported that generation insignificantly affected EM_{FM}.

Line effect on egg production traits:

Quails of the selected line laid more EN_{FM} eggs, higher EM_{FM}, earlier AGE_{FM} (+9.43%, +8.46%, -5.38days), larger CS_{FM} and shorter PDL_{FM} (+25.60% and -11.68 %) than those of the control line (Table 3). Similarly, line had significant effects on EN as reported by many investigators (Narendra Nath *et al.*, 2011, Alkan *et al.*, 2013 , Okenyi *et al.*, 2013 and Meabed, 2015) favoring the selected lines than their controls. Conversely, Farrag (2011) found that the females of selected line for high BW_4 produced lower EN and EM than the control females during 90 days of lay. While, Alkan *et al.* (2013), Meabed (2015) and Mahmoud *et al.* (2016) found significant line effect on EM favoring the selected lines over generations than the control line. Selection for high BW at different ages resulted in significant undesirable increase in clutch number and pause duration length (CN_{FM} and PDL_{FM}) comparing to control line (Karabağ *et al.* , 2010 , Alkan *et al.*, 2013 and Sadeghi *et al.*, 2013). In other words, selection criteria clearly influenced EN, EM, CN and PDL.

Performance of fitness traits:

Generation effect on fitness traits:

As shown in Table 4, the 4th generation had higher fertility% and hatchability% associated with preferably lower early and late embryonic mortality% than other generations however, the 3rd and the 1st generations had the highest early and late embryonic mortality%, (4.74% and 2.01%, respectively) than other generations. Similar trend of significant generation effect on fertility% was reported by Abdel Fattah (2006) and Okenyi *et al.* (2013). However, Farrag (2011) reported insignificant differences due to generations and lines for fertility% and hatchability% from fertile egg. Similarly, Okenyi *et al.* (2013) found insignificant differences due to generations for hatchability from fertile egg%.

Line effect on fitness traits:

Quails of the selected line had preferably higher fertility%, hatchability% (+5.64% and +4.89%) but undesirably higher early embryonic mortality% (+18.06%) than those of the control line. These results are in agreement with the findings of Abdel Fattah (2006) who found that selected lines for higher BW_{42} and GR_{1-42} had higher fertility% and hatchability from fertile egg than control line. Whereas, Farrag (2011) and Sadeghi *et al.*(2013) reported lower fertility% and hatchability from fertile egg for that selected lines than the control line. As well as there were significant differences due to line effect on fertility% and hatchability from fertile egg reported by Farahat *et al.* (2018).

Karagecili and Karadaş (2017) reported that intensive selection applied on commercial poultry caused high metabolic rate of embryos and their nutritional requirements have also increased, deficiency to meet these requirements nutrition has negative effects on some traits such as embryonic development, fertility and hatchability .

Heritability, genetic and phenotypic correlations between GR_{1-21} and egg production traits:

Each of AGE_{10}, BW_{AFE} **and** AFE had higher h^2 of 0.25, 0.24 and 0.20, respectively than other egg production-related and egg production traits ranged from 0.07 to 0.19 as shown in Table 5. Similarly, several authors reported moderate h^2 ranged from 0.21 to 0.37 for AFE (Özsoy and Aktan, 2011 and Abou Khadiga *et al.*, 2016).On the other hand, Hidalgo *et al.* (2011) reported higher h^2 estimates for AFE ranged from 0.53 to 0.75 than h^2 estimates in this study. Heritability estimates for BW_{AFE} and AGE_{10} of this study were in agreement with the reports of other studies BW_{AFE} (Abou Khadiga *et al.*, 2016) being 0.25 and AGE_{10} (Mahmoud *et al.*, 2016) was 0.28. Conversely, Özsoy and Aktan (2011) and Okenyi *et al*. (2013) reported high h^2 estimates for BW_{AFE} being 0.58 and 0.46, respectively. This wide range of h^2 estimates could be due to the differences in populations, method of estimation and statistical models.

The GR_{1-21} had preferably negative correlations either genetically or phenotypically with each of AFE, DN_{10}, AGE_{10}, PDL_{FM} and AGE_{FM} (rg:-0.30, -0.14, -0.09, -0.004 and -0.03 vs rp: -0.12,-0.03, -0.07, -0.013 and -0.01, respectively). On the other hand, GR_{1-21} was genetically and positively correlated in a favorable trend with each of BW_{AFE}, EN_{FM}, EM_{FM} and CS_{FM} (rg: 0.26, 0.36, 0.10 and 0.19). Also, positive phenotypic correlations were found between GR_{1-21} and each of with each of BW_{AFE}, EN_{FM}, EM_{FM}, and CS_{FM} ranged from 0.02 to 0.29. There was negative rp between GR_{1-21} and CN_{FM} being -0.19 (Table 5). No previous information could be found on the studied GR_{1-21} trait and their relationship with egg production performance of Japanese quail. Positive rgs estimates between $BW_{21}$with AFE, DN_{10}, EN and EM were positive and ranged from 0.09 to 0.32, from 1.14 to 1.22, 0.16 to 0.84 and 0.16 to 0.24, respectively as well as, rp estimates were -0.20, -0.14, 0.24 and 0.24, respectively (Emam, 2015). Genetic correlations can arise in several ways as illustrated by Falconer (1989), they can be caused by pleiotropic gene effect, linkage, pleiotropic occurs when one locus affects multiple traits**.**

Genetic gain estimates were favorable but insignificant for most egg production traits **(**AFE, DN_{10}, EN_{FM}, EM_{FM}, AGE_{10} and AGE_{FM}**)** being -1.22, -0.58, +3.07, +13.24, -2.39 and -2.22, respectively. Hence selection based on GR_{1-21} could improve these traits may be due to the genetic correlations between GR_{1-21} and previous traits .Therefore, decreased AFE could increase the number of eggs during the laying period. However, this led to a decrease in egg weight due to the negative genetic and phenotypic correlations between egg weight and egg number .In the current study estimates of genetic gain were undesirably and insignificant effects on BW_{AFE}, AEW_{FM}, PDL_{FM}, CN_{FM} and CS_{FM} (-0.67,-0.51,+0.37,-0.16 and-0.09, respectively).

In conclusion, selection for high GR_{1-21} resulted in favorable negative correlations either genetically or phenotypically with each of AFE, DN_{10} , AGE_{10} , PDL_{FM} and AGE_{FM} and had preferably positive rg' s with each of BW_{AFE}, EN_{FM}, EM_{FM} , CN_{FM} and CS_{FM}. It seemed these previously mentioned productive traits can be indirectly improved through the selection for fast GR_{1-21}. Some estimates of genetic gain were opposite to genetic correlations in direction which may be due to fluctuations in response to selection affecting the means of breeding values, which could be due to the population size.

CONCLUSION

Selection for fast growth rate during the period from 1 to 21 days of age in Japanese quail improved egg production traits which were represented in earlier AFE, $DN_{10}AGE_{10}$ and AGE_{FM}. Also, the selected line had higher BW_{AFE}, EN_{FM}, EM_{FM}, CS_{FM}, and lower CN_{FM} and PDL_{FM} compared with the control line. There were similar trends of improving fertility and hatchability resulted from selection for fast earlier growth rate. Selection for GR_{1-21} had desired genetic gain with most studied egg production traits (AFE, DN_{10}, AGE_{10}, AGE_{FM}, EN_{FM}, EM_{FM} and CN_{FM}). The GR_{1-21} had positive rg and rp with BW_{AFE}, EN_{FM}, EM_{FM} and CS_{FM} traits, in contrary, it had negative rg and rp with AFE, DN_{10}, AGE_{10}, PDL_{FM} and AGE_{FM}, therefore indirect selection could be used to enhance these traits.

Table (1): Female numbers used over four generations of the selection experiment.

Generation	Line	Dams	Total
First	Control line Selected line	139 178	317
Second	Control line Selected line	96 172	268
Third	Control line Selected line	80 180	260
Fourth	Control line Selected line	136 176	312
Total			1157

Table (2): Least square means ± SE for egg production- related traits as affected by generation and line effect.

Item	AFE, day	BW_{AFE}, g	DN_{10}, day	AGE_{10}, day	AEW_{FM}, g
Generation effect:					
First	52.97 ± 0.53^{b}	255.40 ± 1.77^{b}	15.43 ± 0.31^{a}	67.78 ± 0.62^{a}	11.81 ± 0.08^{a}
Second	51.59 ± 0.65^{b}	261.47 ± 2.16^{a}	14.95 ± 0.35^{a}	66.29 ± 0.71^{a}	11.34 ± 0.08^{b}
Third	54.66 ± 0.69^{a}	259.79 ± 2.27^{ab}	13.18 ± 0.38^{b}	67.16 ± 0.77^{a}	11.42 ± 0.09^{b}
Fourth	47.98 ± 0.63^{c}	260.77 ± 2.07^{a}	13.12 ± 0.34^{b}	60.87 ± 0.70^{b}	11.88 ± 0.08^{a}
Line effect:					
Control line	55.21 ± 0.56^{a}	253.01 ± 1.85^{b}	14.97 ± 0.31^{a}	69.10 ± 0.62^{a}	11.73 ± 0.07
Selected line	50.63 ± 0.28^{b}	260.59 ± 0.94^{a}	14.06 ± 0.16^{b}	64.44 ± 0.32^{b}	11.60 ± 0.04
***p*-value**					
Generation	0.0001	0.0304	0.0001	0.0001	0.0001
Line	0.0071	0.0001	0.0077	0.0001	0.0958
Generation*Line	0.0001	0.4697	0.0708	0.0126	0.0001

Means having different superscripts within each effect in the same column are significantly differed at specified probability, SE: stander error, AFE: age at first egg, $BW_{AFE:}$ body weight at first egg, DN_{10}: days needed to produce the first ten eggs, AGE_{10}: age at the first ten eggs, AEW_{FM}: average egg weight in the first month of production, and P: Probability.

Table (3): Least square means ± SE for egg production traits during the first month of Laying as affected by generation and line effect.

Item	EN_{FM}, egg	EM_{FM}, g	AGE_{FM}, day	CN_{FM}	CS_{FM}, day	PDL_{FM}, day
Generation effect:						
First	20.21±0.34^{b}	240.84±4.52^{c}	82.97±0.53^{b}	5.59±0.11^{b}	4.00±0.19^{c}	2.32±0.07^{a}
Second	20.31±0.36^{b}	231.16±4.85^{c}	81.59±0.65^{b}	6.07±0.12^{a}	3.68±0.20^{c}	2.13±0.13^{a}
Third	24.34±0.40^{a}	278.38±5.32^{b}	84.67±0.69^{a}	4.22±0.13^{c}	6.64±0.22^{a}	1.85±0.13^{b}
Fourth	24.53±0.35^{a}	291.32±4.75^{a}	77.98±0.63^{c}	4.42±0.12^{c}	6.06±0.19^{b}	1.76±0.12^{b}
Line effect:						
Control line	20.68±0.32^{b}	243.11±4.34^{b}	85.21±0.56^{a}	5.50±0.06^{a}	4.14±0.18^{b}	2.14±0.10^{a}
Selected line	22.63±0.16^{a}	263.67±2.21^{a}	80.63±0.28^{b}	5.04±0.11^{b}	5.20±0.09^{a}	1.89±0.05^{b}
***p*-value**						
Generation	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Line	0.0001	0.0001	0.0001	0.0001	0.0001	0.0296
Generation*Line	0.2792	0.0002	0.0011	0.0002	0.0011	0.0173

Means having different superscripts within each effect in the same column are significantly differed at specified probability, SE: stander error, EN_{FM}: number of eggs produced in the first month of production, EM_{FM}: egg mass for the first month, CN_{FM}: clutch number for the first month, CS_{FM}: clutch size, PDL_{FM}: pause duration length, AGE_{FM}: age after first month of production and P: Probability.

Table (4): Least square means ± SE for fitness traits during the first month of Laying as affected by generation and line effect

Item	Fertility %	Hatchability %	Early embryonic mortality %	Late embryonic mortality%
Generation effect:				
First	69.50±1.32^{d}	65.40±1.55^{c}	1.79±0.14^{b}	2.01±0.08^{a}
Second	80.66±1.33^{c}	79.25±1.54^{b}	1.42±0.15^{c}	1.40±0.10^{b}
Third	85.56±1.65^{b}	54.48±1.90^{d}	4.74±0.13^{a}	1.44±0.12^{b}
Fourth	88.20±1.62^{a}	85.42±1.86^{a}	1.23±0.16^{c}	1.28±0.10^{b}
Line effect:				
Control line	76.38±0.13^{b}	70.68±1.46^{b}	2.27±0.12^{b}	1.68±0.08
Selected line	80.69±0.07^{a}	74.14±0.92^{a}	2.68±0.08^{a}	1.54±0.05
***p*-value**				
Generation	0.0001	0.0001	0.0001	0.0001
Line	0.0029	0.0385	0.0039	0.1451
Generation*Line	0.7730	0.5416	0.3175	0.7427

Means having different superscripts within each effect in the same column are significantly differed at specified probability, SE: stander error and P: Probability.

Table (5): Heritability, genetic gain, genetic and phenotypic correlations ±SE between GR_{1-21} and egg production traits.

Correlated trait	h^2±SE	rg±SE	rp±SE	Genetic gain ± SE
AFE	0.20±0.007	-0.30±0.09	-0.12±0.04	-1.22 ± 0.1^{ns}
BW_{AFE}	0.24±0.001	0.26±0.09	0.02±0.03	-0.67 ± 0.05^{ns}
DN_{10}	0.07±0.030	-0.14±0.06	-0.03±0.03	-0.58 ± 0.02^{ns}
EN_{FM}	0.17±0.008	0.36±0.05	0.29±0.05	3.07 ± 0.20^{ns}
EM_{FM}	0.19±0.007	0.10±0.09	0.12±0.03	13.24 ± 134^{ns}
AEW_{FM}	0.17±0.008	-0.09±0.03	0.08±0.03	-0.51 ± 0.09^{ns}
PDL_{FM}	0.07±0.006	-0.004±0.004	-0.013±0.003	0.37 ± 0.05^{ns}
CN_{FM}	0.09±0.004	0.04±0.004	-0.19±0.040	-0.16 ± 0.01^{ns}
CS_{FM}	0.17±0.003	0.19±0.02	0.02±0.004	-0.09 ± 0.001^{ns}
AGE_{10}	0.25±0.006	-0.09±0.02	-0.07±0.04	$-2.39\pm.09^{ns}$
AGE_{FM}	0.17±0.008	-0.03±0.007	-0.01±0.008	-2.22 ± 0.30^{ns}

h^2: heritability, rg: genetic correlation, rp: phenotypic correlation, SE: stander error, AFE: age at first egg, $BW_{AFE:}$ body weight at first egg, DN_{10}: days needed to produce the first ten eggs, AGE_{10}: age at the first ten eggs, AEW_{FM}: average egg weight in the first month of production, EN_{FM}: number of eggs produced in the first month of production, EM_{FM}: egg mass for the first month, CN: clutch number for the first month, CS: clutch size, PDL: pause duration length, AGE_{FM}: age after first month of production and ns: non-significant.

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الملخص العربى

تأثير الانتخاب لمعدل النمو السريع على الأداء الانتاجى للسمان اليابانى البياض وصفات الموائمة

بثينه يوسف فؤاد محمود [1]، دعاء عبد الحميد محمود صميده [1]، إنصاف أحمد الفل[1] و أحمد محمد إمام[1]

[1] قسم انتاج الدواجن - كلية الزراعة - جامعة الفيوم

يهدف العمل الحالى الى دراسة أثر الانتخاب لمعدل النمو السريع على صفات انتاج البيض وصفات الموائمة للسمان اليابانى البياض باستخدام 1157 أنثى سمان يابانى (706 أنثى للخط المنتخب و 451 لخط المقارنة) . وكانت أهم النتائج المتحصل عليها كالتالى:

أثر جيل الانتخاب تأثيرا معنويا على كل صفات انتاج البيض المدروسة وكان الجيل الرابع من الانتخاب الأبكر لكل من لصفات العمر عند أول بيضة والعمر بعد وضع أول عشر بيضات مصحوبا بوزن جسم هو الأثقل عند وضع أول بيضة أ يضا الفترة الازمة لإنتاج أول 10 بيضات كانت أقل وكان متوسط وزن البيض أثقل مقارنة بالأجيال الأخرى. وكان للجيل الرابع أيضا عدد بيض أعلى وكتلة بيض أثقل فى الشهر الأول للانتاج كما كانت له فترة توقف عن الانتاج أقل مقارنة بالأجيال الأخرى. ويزيد على ذلك انه كانت للجيل الرابع نسبا أعلى للخصوبة وللفقس مقرونة بنسب أقل للنفوق الجنينى المبكر والمتأخر مقارنة بالأجيال الأخرى.

كان للخط المنتخب عمرا أقل عند انتاج أول بيضة ووزن جسم أثقل عند انتاج أول بيضة وعدد الأيام اللازمة لانتاج أول عشر بيضات أقل وكذلك العمر بعد انتاج أول عشر بيضات وانتاج عدد بيض أكبر وكتلة بيض أثقل وعمرا أقل لانتاج الشهر الأول من البيض وحجم سلسلة بيض أكبر وفترة توقف عن انتاج البيض أقصر كما كان له نسب خصب وفقس أعلى غير أنه كانت وبشكل غير مرغوب فيه نسبة النفوق الجنينى المبكر له أعلى مقارنة بخط الكنترول.

و بما أن الانتخاب لمعدل النمو فى الفترة من 1 الى 21 يوم من العمر قد نتج عنه ارتباطا سالبا مرغوبا فيه سواء وراثيا أو مظهريا مع كل من صفات العمر عند أول بيضة، عدد الأيام اللازمة لانتاج أول عشر بيضات، العمر بعد انتاج أول عشر بيضات، فترة التوقف عن انتاج البيض، العمر بعد الشهر الأول من انتاج البيض وكان له بشكل أفضل ارتباطا وراثيا موجبا مع كل من وزن الجسم عند أول بيضة، عدد البيض وكتلة البيض وعدد سلاسل البيض وحجم سلسلة البيض المنتج فى الشهر الأول من الانتاج فانه يبدو أن تلك الصفات يمكن تحسينها بشكل غير مباشر نتيجة الانتخاب لصفة معدل النمو السريع من 1 الى 21 يوم من العمر.