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SELECTION BY INDEPENDENT CULLING LEVELS FOR SOME EGG PRODUCTION TRAITS IN JAPANESE QUAIL

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Abstract

The present study aimed to improve the genetic potentialities of production traits in the Japanese quail through four generations of selection by using the independent culling levels technique to develop line for egg production (L2), as well as, the control line (L1). Egg production traits including body weight and age at sexual maturity, number and weight of eggs until 90 days of age and feed conversion during 11-13 weeks of age were obtained in each generation. Moreover, the genetic and phenotypic parameters for the above traits were estimated in each generation. The main results and conclusions were; average egg number ranged between 33.83 to 37.14 eggs for L2 and 19.35 to 26.04 eggs for L1. The quails of the L2 had the approximately equal mean (2.48 to 2.64 g. feed / g. eggs) over the three generations with highly significant differences among all sources of variance studied. The differences among generations or lines were highly significant for body weight at sexual maturity, age at sexual maturity, egg number and egg weight until 90 days of age. The results showed a decrease in the mean of the egg number in the 3rd generation than those of the base ones, while, L2 (selected line for egg production) had higher mean of the egg production (35.19 eggs) than line L1 (23.93 eggs). The heritability estimates for egg production traits of L2 ranged from low (age at sexual maturity) to moderate (egg weight) and high (body weight at sexual maturity and egg number).

INTRODUCTION

Research work in poultry is often handicapped by limits of budget, times and space. Wilson *et al.*,(1961) suggested a Japanese quail (Coturnix coturnix japonica) as a pilot animal for more expensive experiments on chickens and turkeys.

In past, the tradition of quail production has been mainly related to the research work, but, new days quails became widely distributed in Egypt and others as a source of meat production since their meat and eggs have become highly popular to the consumers, Quail is a good source of animal protein (Singh *et al.*,1981).

Egg selected lines have reduced body weights whereas heavy- meat type birds are relatively poor egg producers. It has been well documented in coturnix (Nestor and Bacon, 1982). Turkeys (Nestor, 1977) stated that egg production and body weight were genetically negatively correlated.

The aim of the present study was conducted to study the direct and correlated response of four generations of selection for improving egg number and feed conversion by the method of independent culling levels selection in one selected line of Japanese quail.

MATERIALS AND METHODS

The experiment continued for four generations with two lines of Japanese quail (Bahie El-Deen, 1994) in order to continue the study on the effect of selection by independent culling level method on egg production traits.Two lines were taken, for egg production line (L2), and control line (L1) after four generations of selection by selection index method (Bahie El-Deen, 1994) to evaluate the two methods of selection.The mating system used in the present study was a ratio of one male with two females avoiding full or half-sibs mating. The method of selection was the females which gave higher egg number than the line mean and these were selected in the first step, other birds were culled, secondly the selected females had best feed conversion for egg production through 11-13 wks of age than the line mean bring taken as a parent stocks for the next generation.

Birds were banded and brooded on the floor at a starting temperature of 37°C for the first week, then, decreased 2-3°C weekly. Feed and water were provided *ad libitum.* A diet containing 28%CP with 2819 ME kcal/kg was used until 14 days of age. A diet containing 26% CP with 3213 ME kcal/kg was used during the period from 15 to 52 days of age and a diet containing 21%CP with 2609 ME kcal/kg was used during the production period.

Studied traits were

1. Body weight at sexual maturity in grams.
2. Age at sexual maturity in days.
3. Egg number (egg) until 90 days of age.
4. Egg weight through 90 days of age.
5. Feed conversion for egg production during period 11-13 weeks of age as a ratio of feed intake in grams to the egg weight in grams.

Statistical analysis

The statistical analysis was performance least squares system (SAS version 6, 1990).

The data for egg production traits and feed conversion within two lines over the three generations were as follows:

$Y_{ijk} = \mu + L_i + G_j + (LG)_{ij} + e_{ijk}$

Where: μ : is the overall mean,

L_i : is the effect of lines, i =1-2,

G_j : is the effect of generations, j =1-4,

$(LG)_{ij}$: is the interaction ,

e_{ijk} : is the remainder error

Genetic Parameters

Another analysis was performed according to the following model (Harvey, 1987):

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

Where: μ: is the overall mean,

S_i: is the effect of the i^{th} sire,

e_{ij}: is the random error.

All factors of this model were assumed to be randomly and independently distributed. Sire variance and covariance components were estimated using method 3 of Henderson (1953). Heritability estimates were calculated according to the formula by (Becker, 1985) and standard error (S. E.) of the heritability was estimated by using the formula by (Swiger *et al.* 1964).

The coefficient of phenotypic correlation (r_P) between different traits studied were obtained by using the following formula *(Becker, 1985).*

$$r_{p_{x,y}} = \frac{(\text{cov S} + \text{cov E})}{\sqrt{[(\text{var} S_x) + (\text{var} E_x)] X [(\text{var} S_y) + (\text{var} E_y)]}}$$

where : $r_{px,y}$: is the phenotypic correlation coefficient,

cov (E_x): is the error variance component of trait X,

cov (E_y): is the error variance component of trait y.

Genetic Phenotypic correlation coefficient between any two traits were computed by formula (Becker, 1985).

$$r_{G_{x,y}} = \frac{\text{cov S}}{\sqrt{[\text{var}(S_x) X [\text{var}(S_y)]}}$$

where : $rG_{x,y}$: is the genetic correlation coefficient,
cov S : is the sire genetic covariance between traits x & y,
var (S_x): is the sire variance component of trait x,
var (S_y): is the sire variance component of trait y.

RESULTS AND DISCUSSION

Selection and direct response

Least square means of egg number produced until 90 days of age by line: selected line (L2) and control line (L1) over the three generations of selection, are presented in Table 1. The average egg number ranged between 33.83 to 37.14 eggs for L2, and 19.35 to 26.04 eggs for L1 ver three generations of selection.The analysis of variance revealed highly significant ($P \leq 0.01$) differences among all sources studied (Table 1).

In general, the three generations of selection for increase in egg number had the lowest increment (-1.02 eggs). Similar results were reported by Omran (1993), who estimated the decrease in egg production of quail during the first 30 days of lay by the rate of –5.30 and –3.90 eggs per generation. On the other hand, Bahie El-Deen (1994) reported that increase of egg number in Japanese quail was (0.58 eggs over the four generations of selection, and Shebl *et al.* (1996) obtained an increase by 4.8 % in egg number.

The efficient performance for egg production included, egg number, egg weight and feed consumption; these traits were studied during 11-13 weeks of age to evaluate feed conversion ratio. Least square means of feed conversion during 11-13 weeks of age by lines (L2 and L1) over three generations of selection are presented in Table 1. The quails of L2 had approximately equal mean 2.48 to 2.64 g. feed / g. eggs over the three generations. Highly significant ($P<0.01$) differences among all sources studied were found (Table 1). The means of feed conversion for egg production in control line (L1) were 4.87 g. feed / g. eggs in the first generation and 3.34 g. feed / g. eggs in the third one.

This result indicated that there was a highly environmental variation among generation in the control line (L1) which affected also the selected line (L2).

Slight decrease in egg production through 12-15 weeks of age was found by Yehia (1992) as a result of selection for feed efficiency of egg production in quails.

In conclusion, simultaneous selection for egg number till 90 days of age and feed conversion for egg production during 11-13 weeks of age using independent culling levels resulted in accumulated genetic reduction equal to (-1.02 eggs) for egg number, as well as, an increase equal to (1.51 g. feed/g. egg) in feed conversion.

Bordas and Merat (1991) used laying hens from 2 lines, selected for high and low residual components of feed intake in the laying period. They found that selection for higher daily protein intake causes a higher body weight, feed efficiency of egg production.

Correlated response

Body weight at sexual maturity (BWSM)

Least square means for body weight at sexual maturity (BWSM) by lines over the three generations of selection are presented in Table 2.

It was noted that the base generation had significantly lower overall mean of body weight at sexual maturity than other generations. The means of lines in that respect ranged from 207.60 to 222.76 g for L2 and from 212.50 to 221.53 g for L1. Highly significant ($p<0.01$) differences among generations or lines were found (Table 2).

Generally, the results indicated the superiority of the selected body weight lines over the control within generation means. Similar results were reported by Shebl *et al.* (1996).

Age at sexual maturity (ASM)

Least square means for age at sexual maturity (ASM) by lines over the three generations of selection are presented in Table 2.

The means of age at sexual maturity (ASM) lowered in the third generation of selection than other generations. Also, quails in L2 selected for egg production had lower age at sexual maturity than L1. However, Praharaj *et al.*(1992) reported that the quail control line matured later than those of selected one for body weight.

Generally, In the third generation, this trait decreased in L2 (selected for egg production) compared with L1 (control line). Differences among generations and lines were highly significant ($P\leq0.01$) (Table 2).

These results are in agreement with the findings of Bahie El-Deen (1994), Shebl *et al.* (1996).

Average Egg weight till 90 days of age

Least square means for egg weight produced during 90 days of age by lines over the three generations of selection are presented in Table 2.

The generation mean for egg weight during 90 days of age was higher in the base and third generations of selection than other generations. Also, L2 had higher egg weight than L1 in the base generation and second and third generations. Highly significant ($P \leq 0.01$) differences among generations and lines were observed as shown in Table 2. Similar results to the present egg weight means were reported by Bahie El-Deen (1994).

The heritabilities and phenotypic and genetic correlations for egg production traits for lines (1 and 2) are presented in Table 3.

Heritability estimates from sire component of variance for L1 (Control line) for body weight at sexual maturity and egg weight were high values (0.61 and 0.91, respectively), but, moderate values were found for age at sexual maturity and egg number (0.21 and 0.22, respectively).

These estimates for L2 (egg line) ranged from low (age at sexual maturity) to moderate (egg weight) and high (body weight at sexual maturity and egg number). Lower values had been reported by Yehia (1992) and Shebl *et al.* (1996).

The phenotypic correlation among age at sexual maturity and other egg production traits were negative, but, positive values were found among body weight at sexual maturity and each of egg weight and egg number.

In L2, the genetic correlations among age at sexual maturity and each of other egg production traits were negative and ranged between (-0.03 to –0.36), but, positive values were found among body weight at sexual maturity and each of egg weight (0.54) and egg number (0.01).

The phenotypic correlation between egg number and egg weight was positive (0.2), but, the corresponding value with age at sexual maturity was high and negative (-0.66).

Genetic and phenotypic correlations among egg production traits had been reported by Bahie El-Deen (1994).

Table 1. Least squares means (X) and standard errors (S.E) for egg number through 90 days (egg) and feed conversion for egg production from 11 to 13 weeks of age (gm.feed/gm.egg mass).

Traits	Line	Generation				Overall mean
		0	1	2	3	
Egg. No.	L_2	35.54±0.76	35.09±0.48	37.14±0.82	33.83±0.78	35.19± .34
	L_1	20.04±1.29	25.58±0.54	26.04±0.75	19.35±0.65	23.93 ± .39
F.Conv.	L_2	2.50±0.10	2.52±0.05	2.64±0.18	2.48±0.07	2.52 ± .04
	L_1	4.87±0.83	3.26±0.14	3.02±0.09	3.34±0.09	3.44 ± .13

Significant	Egg no.	F.Conv	
L	**	**	
G	**	**	
LxG	**	**	

**Highly significantly p≤ 0.01.

Table 2. Least squares means (X) and standard errors (S.E.) for body weight at sexual maturity (BWSM) (gm.), age at sexual maturity (ASM) (days) and egg weight (gm) until 90 days of age (EW) by lines (L) and generations (G).

Traits	Line	Generation			
		0	1	2	3
BWSM	L_2	207.60±1.98	222.76±1.59	212.41±2.15	213.71±1.81
	L_1	212.50±3.35	216.94±1.27	212.72±2.54	221.53±3.07
ASM	L_2	49.22±0.62	50.75±0.56	49.61±0.79	49.32±0.74
	L_1	62.49±1.17	59.31±0.56	56.81±0.87	64.13±0.73
EW	L_2	11.37±0.06	10.78±0.02	10.35±0.09	11.08±0.08
	L_1	10.80±0.09	10.78±0.02	10.01±0.08	10.78±0.07
Significant		BWSM	ASM	EW	
L		**	**	**	
G		**	**	**	
LxG		**	**	**	

**Highly significantly $p \leq 0.01$.

Table 3. Heritabibility (h^2s) estimates (on diagonal), phenotypic (above diagnoal) and genetic (blew diagonal) correlation for egg production traits by generation in the L_2 and L_1 .

Line	Trait*	ASM	BWSM	Egg wt.	Egg No.
L_2	ASM	0.19	0.2	-0.13	-0.66
	BWSM	-0.03	0.83	-0.1	0.1
	Egg wt.	-0.36	0.54	0.39	0.2
	Egg No.	-1	0.01	0.07	0.44
L_1	ASM	0.21	-0.19	-0.002	-0.8
	BWSM	-0.05	0.61	0.1	0.21
	Egg wt.	0.32	-0.32	0.91	0.02
	Egg No.	-0.39	-0.01	-0.05	0.22

*ASM : age at sexual maturity
BWSM : body weight at sexual maturity
Egg wt. : egg weight till 90 days of age
Egg No. : egg number till 90 days of age

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الانتخاب بمستويات الفرز المستقلة لصفات إنتاج البيض فى السمان اليابانى

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أجريت هذه التجربة خلال ٤ أجيال على خطين من السمان اليابانى تم تكوينها بمركز بحوث الدواجن-قسم إنتاج الدواجن-كلية الزراعة-جامعة الإسكندرية و هى:
L1 خط المقارنة
L2 خط منتخب لصفات إنتاج البيض

وذلك بغرض تحسين صفات إنتاج البيض فى السمان اليابانى عن طريق استخدام الانتخاب بمستويات الفرز المستقلة.

وقد شملت التجربة أربعة أجيال متتالية للانتخاب (جيل أساسى + ٣ أجيال تحت الانتخاب).

وقد تم الانتخاب داخل خط البيض (L2)لصفتى عدد البيض حتى عمر ٩٠ يوما و الكفاءة الغذائية لانتاج البيض فى الفترة من عمر ١١-١٣ اسبوعا.

وقد تم تقدير الصفات التالية فى كلا الخطين:

صفات إنتاج البيض والتى شملت عمر البلوغ الجنسى، وزن الجسم عند أول بيضة وإنتاج البيض ومتوسط وزن البيض حتى ٩٠ يوما من الفقس بالاضافه لحساب الكفاءة التحويلية خلال الفترة من ١١-١٣ أسبوعا من العمر.

وكانت أهم النتائج ما يلى:

متوسط عدد البيض تراوح بين ٣٣,٨٣ إلى ٣٧,١٤ بيضة كخط إنتاج البيض وأيضا من ١٩,٣٥-٢٦,٠٤ بيضة كخط الكنترول. الكفاءة التحويلية لإنتاج البيض فى الفترة من ١١-١٣ أسبوعا تراوحت بين ٢,٤٨-٢,٦٤ جم علف/ جم بيض فى خط إنتاج البيض عبر ٣ أجيال من الانتخاب. متوسط وزن البيض عموماً خلال الأجيال المختلفة. أوضحت النتائج انخفاضا فى عدد البيض فى الجيل الثالث عن الجيل الأساسي بينما كان خط L2 أعلى فى عدد البيض من خط L1 فكانت النتائج ١٩,٣٥، ٢٣,٩٣ بيضة على الترتيب. كانت قيمة المكافئ الوراثى فى خط إنتاج البيض فكان منخفض لصفة عمر البلوغ و متوسط لصفة إنتاج البيض و عالى لصفة الوزن عند البلوغ و كذلك عدد البيض.