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PHENOTYPIC AND GENETIC ESTIMATES OF SOME PRODUCTIVE AND REPRODUCTIVE TRAITS IN JAPANESE QUAILS

By

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Abstract: *A random bred population of Japanese quails was reared for four successive generations under proper environmental conditions to estimate genetic and phenotypic parameters of growth and fitness traits. The average of body weight at hatch; two weeks; four weeks and six weeks were 9.15, 8.72 and 8.72 gm; 43.18, 57.13 and 62.85 gm; 11.06, 139.37 and 152.26 gm; and 186.33, 202.95 and 214.72gm for the first, second and third generation, respectively. The ranges of heritability estimates for hatch weight, two weeks, four weeks and six weeks 0.74 to 0.82, 0.24 to 0.90 , 0.16 to 0.30, 0.10 to 0.21. Low heritability estimates were recorded for fertility and hatchability percentages.*

Genetic and phenotypic correlations among body weights at different ages were positive during all generations. Hatch effect showed significant differences among body weight for successive generations as well as sex effect was evident on body weight. Females were heavier than males allover generations. Generation effect was prominent for all studied traits, These results indicated that we can increase body weight of Japanese quails by direct selection for high body weight; on the other hand, improving fertility and hatchability could be done through adjusting the environmental factors.

INTRODUCTION

Japanese quails have been widely used for genetic studies because of their short generation interval and minimum requirements of space and time. Establishment of breeding programs necessitates estimation of the genetic parameters for different productive and reproductive traits.

Body weight were recorded by ***Saatci et al., 2006*** **who** found that the mean of body weight of Japanese quails was 7.6, 20.2, 43.1, 76.8, 114.5, 149.0 and178.0 gm for hatch, one, two, three, four, fife, and six weeks of age; respectively. Meanwhile, ***Shokoohmand et al., 2007*** reported mean body weights in Japanese quail at 14, 28 and 42 days of age as 51.2 , 119.2 and 176 gm; respectively. Effect of sex on body weight was studied by ***Vali et aL, 2005, Abdel Fattah et al., 2006, Saatci et al., 2006, Shokoohmand et al., 2007 and Alkan et al., 2010***. They found that females of Japanese quails were heavier than males. While the effect of generation and hatch were recorded by ***Kumari et al., 2009.*** They represented significant effect on body weight up to four weeks of age only.

In addition sex effect on relative growth rate was recorded by ***Abdel Fattah et al., 2006.*** They were numerically higher in females than for males.

Bahie El-Dean et al., 2008 reported age at sexual maturity in Japanese quail females (days) were 42.98, 50.05 and 61.89 for early age at sexual maturity group, medium and late groups; respectively.

El-Fiky, 1991 found that heritability estimates of body weight at hatch, two, four, and six week body weight were 0.88, 0.19, 0.16, 0.45, and 0.76 ; respectively. While they were 0.57, 0.28, and 0.47 at hatch, two, and four week as recorded by ***Aggrey and Cheng, 1994 and Samuel and Kimberly, 1994.*** Moreover, ***Bahie El–Dean, 1994*** reported that heritability estimate for body weight in Japanese quails from sire components for hatch, two, four and six weeks of age were 0.62, 0.39, 0.36 and 0.29; respectively. ***Saatci et al., 2003*** reported heritability estimates for body weight in Japanese quails were 0.51, 0.32, 0.20, 0.21, 0.20, 0.15, and 0.14 for hatch, first, second, third ,fourth, fifth, and sixth week of age; respectively. ***Abdel Fattah et aL, 2006*** found that heritability for growth rate ranged from 0.01 to 0.71. ***Shebl et aL, 1996*** found that heritability estimates for age at sexual maturity in Japanese quails was 0.28 from sire component, while, ***Bahie El-Dean et aL, 2008*** recorded heritability estimates 0.76, 0.08 and 0.06 for early, medium and late age at sexual maturity groups; respectively. Heritability estimates for fertility and hatchability in Japanese quails were very low and ranged from 0.11 to 0.12 as recorded by ***Sharaf, 1992 and Helal, 1999.***

Marks, 1975 found that phenotypic correlation between hatch and two week, hatch and four week and two week and four week were 0.15 to 0.41, 0.02 to 0.31 and 0.69 to 0.87; respectively. The phenotypic and genetic correlation between hatch and two week body weight in Japanese quails were 0.27 and 0.53 as reported by ***Narrayan, 1977.***

The phenotypic correlation between two week and four week body weight in Japanese quail ranged from 0.91 to 0.98 as estimated by ***Marks,*** *1984*. Meanwhile; ***Darden and Marks, 1988*** reported that phenotypic correlation between two week and four week body weight in Japanese quail ranged from 0.76 to 0.83. In addition Significant correlation coefficient between two week and four week body weight as 0.83, four week and six week body weight 0.77 and 0.69 between two week and six week body weight (***Megeed and Younis, 2006***).

Kardy et al., 1986 reported that the phenotypic and genetic correlations between age at sexual maturity and 6-wk body weight were -0.34 and 0.29. On the other hand, ***El-Fiky , 1991*** stated that the phenotypic and genetic correlations between age at sexual maturity and six week body weight were 0.73 and 0.79; respectively.

The aim of the current study was to quantify and estimate genetic parameters of economic and fitness traits in random mating population of Japanese quails.

MATERIALS AND METHODS

This experiment was conducted on Japanese quail (Coturnix coturnix Japonica) at the Department of Animal Husbandry and Animal Wealth Development, Alexandria University throughout the period from March 2009 to August 2010 as a part of M. Sc. Thesis.

I. Management of Experimental Flock:

I.1. Base generation

A total of 500 two week old quail chicks were wing banded and raised in floor pens by the aid of gas heater to four weeks of age with appropriate environmental conditions, then moved to the cages. Chicks received light for 24 hours during the first two days, then 23 hours forward. Birds were placed in laying cages (25 x 25x 25 cm) at four weeks of age and distributed randomly on 185 sire family with sex ratio of 1: 1. Lighting period was adjusted to 16 hours Light: 8 hours dark during the laying period. Birds were fed ad-libtium on diet containing 21% crude protein and 2975.8 Kcal ME/kg of feed during the brooding period and 21% crude protein and 2894.66Kcal ME/kg during the laying period (**NRC. 1994**).

I.2. The three random mating generations

Birds were obtained on three successive hatches and wing banded according to their sire families. Brooding, feeding and laying management through the three generations were provided to assemble the base generation to provide optimum requirements of the quails. Sire family numbers throughout the three generation were 169, 158 and 143 families; respectively.

I.3. Fertile egg management

Eggs were collected daily after complete sexual maturity. Eggs identified by their families , stored at room temperature lower than 20 ° C and 65% relative humidity (RH) for a week, then disinfected by TH_4 ® (Batch no. 801478 manufactured by SoGeval) 5 cm: 1 liter water by spraying on egg surface. Pedigreed eggs were set in the setting trays depending on their sire families in a forced draft incubator of 37.5 ° C and 65% RH. Eggs were turned automatically every three hours. At the end of the 14^{th} day of incubation eggs were set in pedigree baskets and transferred to the hatcher where the temperature was 37.5 ° C and RH was 70%.

II. Studied traits and Estimations

II.1. Body weight

Body weight was recorded biweekly to the nearest gram at hatch, two, four and six weeks of age.

II.2. Relative growth rate

Relative growth rate was calculated during hatch to six weeks of age according to **(Crampton and Lioyd 1959).**

II.3. Age at sexual maturity (Age at the first egg)

Expressed in days from hatching till the day of the first egg for each female.

II.4. Fertility Percentages

It was recorded for each sire family by the following formula:

Fertility % = (Number of fertile eggs / Total number of eggs set)* 100

II.5. Hatchability Percentages (Scientific)

It was recorded for each sire family by the following formula:

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

III. Genetic parameters

III. 1. Heritability

Heritability was calculated in each generation from sire variance component as **(Becker, 1985):**

$$h^2 = \frac{2\sigma^2{}_s}{\sigma^2{}_s + \sigma^2{}_w}$$

Where:

$\sigma^2 s$ = variance of sire.

$\sigma^2 w$ = variance of remainder.

III. 2. Correlations: (Becker, 1985):

III. 2.1. Genetic correlation: "r_g"

$$r_g = \frac{\text{cov}_s}{\sqrt{\sigma^2_{s(x)} \times \sigma^2_{s(y)}}}$$

Where, cov_s = sire covariance components.

$\sigma^2 s_x$= sire variance components for trait (x).

$\sigma^2 s_y$ = sire variance components for trait (y).

III.2.2. Phenotypic correlation: "r_p"

$$r_p = \frac{\text{cov}\, s + \text{cov}\, w}{\sqrt{(\sigma^2_{s(x)} + \sigma^2_{w(x)})(\sigma^2_{s(y)} + \sigma^2_{w(y)})}}$$

Where, Cov_s = sire covariance components

Cov_w = within sire covariance components

$\sigma^2 s_x$ = sire variance components for trait (x)

$\sigma^2 s_y$ = sire variance components for trait (y)

$\sigma^2 w_x$ = within variance components for trait (x)

$\sigma^2 w_y$ = within variance components for trait (y)

IV. Statistical analysis

Percentages of fertility and hatchability were transformed to the corresponding arcsine value according to **Snedecor and Cochran, 1981.**

Statistical analysis was done by the aid of **SAS software, 2004** according to the following models.

IV. 1. Statistical models

IV. 1. 1. Body weights

$$X_{ijkl} = \mu + G_i + H_j + S_k + GH_{ij} + GS_{ik} + e_{ijkl}$$

Where:

X_{ijkl} = the X [th] observation of the i [th] generation, j[th] hatch and k[th] sex.

μ = overall mean.

G_i = effect of i [th] generation (i = 0, 1, 2, 3).

H_j = effect of the j [th] hatch (j = 1, 2, 3).

S_k = effect of k[th] sex (k = male and female).

GH_{ij} =Interaction between i [th] generation and j [th] hatch.

GS_{ik} = Interaction between i [th] generation and k[th] sex.

e_{ijkl} = random error.

IV. 1. 2. Heritability and genetic correlations

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

Where:

X_{ij} = is the trait

μ = population mean.

S_i = effect of sire family

e_{ij} = Remainder.

Significant differences between means were ranked by using Duncan's Multiple Range Test **(Duncan, 1955).**

RESULTS AND DISCUSSION

I. Body weight as affected by Sex and Hatch

I.1. Hatch Weight

Body weight at hatch was 9.2 g for first generation and statistically was significantly different from those of the second and third generation 8.72 and 8.72 g, respectively (Table, 1). These results agreed with ***Mona, 2008***.

Body weight of males and females within the same generation were not significantly different (Table, 2), Males and females of first generation had body weight significantly different from those of second and third generation.

Hatch weights in the first, second and the third generation were 9.17 and 9.14 g, 8.73 and 8.71 g and 8.70 and 8.73 g for males and females, respectively.

Hatch had significant effect on hatch weight (Table, 3). These results agreed with ***Kumari et al., 2009*** who reported significant effect for hatch on body weight.

I.2. Two Week Body Weight

Third generation showed higher significant body weights at two weeks of age than those of the first and second generations. Means of body weight were 43.2, 57.1 and 62.9g for the first. second and third generations; respectively (Table. 1). The same trend was recorded for sex effect on two weeks body weight, where males and females of the same generation were not significant, but they were significant between generations (Table, 2). Similar results were reported by ***Saatci et al., 2003; Saatci et al., 2006; Shokoohmand et al., 2007 and Alkan et al., 2010.*** Hatch had statistically significant effect on two weeks body weight (Table, 3), and confirmed by ***Kumari et al., 2009.***

I.3. Four Week Body Weight

Third generation expressed highest significant four weeks body weight (152.3 g) followed by the second generation (139.4 g) while the lowest four week body weights recoded in the base and the first generation (111.9 and 111.06 g) (Table 1).

Four weeks body weight represented superiority of females over males for all generations (Table, 2). These results agreed with ***Soltan et al., 1987, Abdel-Fattah et al., 2006 and Saatci et al., 2006.*** They found that females of Japanese quails were heavier than males in body weight.

Hatch effect (Table, 3) was significant for four weeks body weight. These results were confirmed by ***Vali et al., 2005*** who reported significant differences for body weights among hatches.

I.3. Six Week Body Weight

Averages of six-week body weights were 172.21, 186.33, 202.95 and 214.72 g for the base, first, second and third generations (Table 1). The highest significant weight was for the third generation and the lowest was for the base generation. Significant differences for body weight among generations were reported by ***Vali et al., 2005; Shokoohmand et al., 2007 and Alkan et al., 2010.***

Effect of sex was significant within the same and among generations, where females were heavier than males (Table, 2). These results agreed with ***Soltan et al., 1987, Abdel-Fattah et al., 2006 and Saatci et al., 2006.***

Significant differences were recorded for six week body weight among different hatches (Table, 3). The same trend was recorded by ***Vali et al., 2005.***

II. Relative Growth Rate

Relative growth rate (RGR) was significantly different from hatch to two week of age and ranged from 128.39 to 150.88 % for the first and third generations, Relative growth rate of the second generation was 146.3 %, and similar to those results obtained by ***Mona, 2008 and Taha, 2009.***

The first generation had the highest significant RGR as 88.42 % for period from two to four weeks and this record agreed with that obtained by ***Taha, 2009***. While RGR of the second and third generations was the same (83.3 and 83.2 %), (Table 4). The same trend was recorded for RGR for the period from four to six weeks of age, where the first generation was the highest significant RGR (50.7 %) followed by the second generation (37.3 %) and the lowest was the third generation (33.7 %). On the other hand, third generation had the highest significance for RGR from hatch to six weeks (184.2 %), followed by the second generation (183.2 %) and the lowest was the first generation (181.1 %). These results agreed with those reported by ***Mona, 2008***.

III. Fertility and Hatchability Percentages

Fertility percentage ranged from 94.05 to 96.79 % and the highest significant percentage was recorded for the first generation, while the lowest was for the second generation. These results agreed with ***El-Hammady et al., 2001*** who found significant differences for fertility percentages among generations. Significant differences among generations were recorded for hatchability percentages. The third generation represented the highest significant percentage (82.3 %), while the lowest was recorded for the second generation (69.7 %) (Table, 5). The same pattern of results was recorded by ***El-Hammady et al., 2001 and Taha., 2009.***

IV. Age at Sexual Maturity

Age at sexual maturity differed significantly among generations (56.04, 54.38, 49.77, and 45.58 days), for the base, first, second, and third generation; respectively.

Birds of the third generation reached sexual maturity earlier than those of the base, first, second and the third generations (Table, 5). These results agreed with ***Taha 2009,*** who found significant differences among generations for age at sexual maturity.

V. Genetic parameters

V.1. Heritability estimates

V.1.1. Body weight

Heritability estimates for hatch weight was very high ranged from 0.74 to 0.82 of the three generations (Table 6). These estimates agreed with those recorded by ***Narrayan, 1977, Soltan et al., 1987 and El-Fiky., 1991.*** Heritability estimates for two weeks body weight ranged from moderate to very high(0.24 to 0.90) among generations and these figures agreed with ***Aggrey and Cheng., 1994, Samuel and Kimberly., 1994, Shalan, 1998, Saatci et al., 2003 and Mona, 2008.***

Four weeks body weight had moderate heritability estimates ranged from 0.16 to 0.30. These values parallel to those obtained by ***Bahie El-Dean, 1994; Helal, 1999 and Mona, 2008.*** Heritability estimates for six weeks body weight ranged from low to moderate (0.10 to 0.21) for the three generations (Table, 6). These results agreed with ***Suda et al., 2002; Vali et al., 2005 and Bahie El-Dean et al ., 2008.*** It is evident that most of traits have medium to high heritability values. This suggests that the traits can be improved through individual selection.

V.1.2. Age of sexual maturity

Age at sexual maturity recorded heritability estimates ranged from low to high (0.07 to 0.44) for the three generations (Table, 8). These values agreed with those reported by ***Bahie El-Dean et al., 2008.***

V.1.3. Relative growth rate

Heritability of relative growth rate from hatch to two weeks ranged from high to very high (0.46 to 0.91) for the three generations (Table, 7). While those of two to four weeks ranged from moderate to very high (0.20 to 0.91) for the three generations. These estimates agreed with ***Mona, 2008.*** Heritability for relative growth rate from four week to six weeks ranged from low to very high (0.05 to 0.82) for the three generations (Table, 7). Moreover; heritability estimates for RGR from hatch to six weeks body weight ranged from moderate to high (0.23 to 0.38) for the three generations.

V.1.4. Fertility and hatchability percentages

tability for fertility was generally low and ranged from 0.01 to 0.11 (Table, 8). In addition, heritability estimates for hatchability percentages ranged from low to moderate (0.06 to 0.16). The same results were obtained by ***Sharaf, 1992 and Helal, 1999.***

Generally most of these heritability estimates were in biological limits, while few of these estimates were out of these limits this may be due to uncontrolled effects of sex and generation (**Michaska, 1992**) in addition to method of analysis.

V.2. Correlation estimates

V.2.1. Genetic and phenotypic correlations among body weights at different stages of growth

Genetic and phenotypic correlations among body weights at different ages for the first, second and third generations, are presented in Tables 9; 10 and 11; respectively.

Phenotypic correlations between hatch weight and other body weights (2^{nd}, 4^{th}, and 6^{th} week) were low and ranged from (0.03 to 0.25), while the corresponding genetic correlation ranged from (-0.02 to 0.53) for the three generations. On the other hand, phenotypic correlation between the 2^{nd} week and those of 4^{th}, 6^{th} week body weight ranged from medium to very high (0.43 to 0.86). The corresponding genetic correlations were medium to very high (0.35 to 0.97) for the three generations.

Phenotypic correlations between the 4^{th} and 6^{th} week body weight ranged from (0.53 to 0.65), while the corresponding genetic correlations ranged from (0.61 to 0.86) for the three generations.

These results observed in this study agreed with those reported by ***Sharaf, 1992; Bahie El-Dean, 1994; Saatci et al., 2003 and Megeed and Younis., 2006.***

V.2.2. Genetic and phenotypic correlations between six week body weights and age at sexual maturity.

Phenotypic correlations between age at sexual maturity and the 6^{th} week body weight were -0.34, -0.03 and -0.65 while genetic correlations 0.65, -0.98 and -0.84 for the three generations (Table, 12). The same results were obtained by ***Kardy et al., 1986 and El-Fiky, 1991.***

Most of traits were positively correlated, which indicates that they can be simultaneously improved while the negatively related ones show that improving one will be at detriment of the other.

It will be concluded that body weight of Japanese quails could be improved by direct selection for high body weight; on the other hand, improving fertility and hatchability could be done through adjusting the environmental factors.

Table (1): Means ± standard deviations for hatch, 2-wk, 4-wk. and 6-weeks body weight of Japanese quails throughout four successive generations.

Generation	Number of birds	Hatch wt	2wk wt	4wk wt	6wk wt
		$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD
Base	482	–	–	111.90 ± 14.85^{c}	172.21 ± 22.45^{d}
First	1563	9.15 ± 0.89^{a}	43.18 ± 8.72^{c}	111.06 ± 15.45^{c}	186.33 ± 22.19^{c}
Second	1022	8.72 ± 0.88^{b}	57.13 ± 8.27^{b}	139.37 ± 22.92^{b}	202.95 ± 28.53^{b}
Third	983	8.72 ± 0.88^{b}	62.85 ± 7.37^{a}	152.26 ± 14.81^{a}	214.72 ± 25.60^{a}

Means within the same column bearing different super script are significantly different ($p < 0.05$)

Table (2): Means ± standard deviations for hatch, 2-wk, 4-wk, and 6-weeks' body weight of Japanese quails throughout four successive generations according to sex.

Generation	Sex	Number of birds	Hatch wt	2wk wt	4wk wt	6wk wt
			$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ±SD	$\overline{X}$ ±SD
Base	M	204	–	–	108.02 ± 13.76^{f}	165.22 ± 20.41^{h}
	F	278	–	–	114.75 ± 15.00^{e}	177.35 ± 22.52^{g}
First	M	764	9.17 ± 0.87^{a}	42.61 ± 8.49^{c}	107.81 ± 14.29^{f}	180.98 ± 19.48^{f}
	F	799	9.14 ± 0.91^{a}	43.73 ± 8.92^{c}	114.17 ± 15.89^{e}	191.45 ± 23.38^{e}
Second	M	539	8.73 ± 0.88^{b}	56.98 ± 7.80^{b}	137.58 ± 22.00^{d}	195.44 ± 24.07^{d}
	F	483	8.71 ± 0.87^{b}	57.30 ± 8.78^{b}	141.36 ± 23.78^{c}	211.33 ± 30.73^{b}
Third	M	508	8.70 ± 0.91^{b}	62.45 ± 6.90^{a}	150.30 ± 13.98^{b}	202.04 ± 19.85^{c}
	F	475	8.73 ± 0.86^{b}	63.29 ± 7.82^{a}	154.35 ± 15.39^{a}	228.28 ± 24.07^{a}

Means within the same column bearing different super script are significantly different ($p < 0.05$)

Table (3): Means ± standard deviations for hatch, 2-wk, 4-wk, and 6-weeks' body weight of Japanese quails throughout four successive generations according to hatch.

Generation	Hatch	Number of birds	Hatch wt	Week2	Week4	Week6
			$\overline{X}$ ±SE	$\overline{X}$ ±SE	$\overline{X}$ ±SE	$\overline{X}$ ±SE
Base	1	482	–	–	111.90 ± 14.85[d]	172.21 ± 22.45[f]
First	1	500	9.06 ±0.84[b]	40.56 ±6.30[d]	110.30 ±16.47[d]	192.21 ±20.74[c]
	2	653	9.28 ±0.88[a]	40.59 ±7.55[d]	111.29 ±15.33[d]	181.71 ±23.80[e]
	3	410	9.07 ±0.95[b]	50.51 ±8.85[c]	111.62 ±14.34[d]	186.54 ±19.37[d]
Second	1	721	8.65 ±0.89[d]	60.12 ±6.99[b]	149.71 ±17.54[b]	206.52 ±30.74[b]
	2	301	8.90 ±0.83[c]	49.96 ±6.52[c]	114.59 ±13.34[c]	194.41 ±19.97[c]
Third	1	983	8.72 ±0.88[d]	62.85 ±7.37[a]	152.26 ±14.81[a]	214.72 ±25.60[a]

Means within the same column bearing different super script are significantly different ($p< 0.05$)

Table (4): Means ± standard deviations for Relative Growth Rate during hatch to six weeks of age of Japanese quails of three successive generations

	R 0-2	R 2-4	R 4-6	R 0-6
Generation	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD
First	128.39 ± 11.99[c]	88.42 ± 12.36[a]	50.68 ± 10.78[a]	181.05 ± 2.76[c]
Second	146.25 ± 8.05[b]	83.28 ± 7.36[b]	37.34 ± 15.75[b]	183.22 ± 2.75[b]
Third	150.88 ± 6.16[a]	83.24 ± 5.40[b]	33.73 ± 9.96[c]	184.20 ± 2.35[a]

Means within the same column bearing different super script are significantly different ($p< 0.05$)

- R 0-2 (relative growth rate from hatch to two weeks).
- R 2-4 (relative growth rate from two to four weeks).
- -R 4-6 (relative growth rate from four to six weeks).
- -R 0-6 (relative growth rate from hatch to six weeks).

Table (5): Means ± standard deviations for fertility and hatchability percentages as well as age at sexual maturity (days) of base and three successive generations.

G	N	Fertility percentage	Hatchability percentage	Age at sexual Maturity (days)	
		$\overline{X}$ ± SD	$\overline{X}$ ± SD	N	$\overline{X}$ ± SD
Base	508	94.11 ± 12.00[b]	78.94 ± 20.09[b]	185	56.04 ± 3.30[a]
First	481	96.79 ± 8.67[a]	78.51 ± 21.14[b]	169	54.38 ± 3.77[b]
Second	441	94.05 ± 13.08[b]	69.70 ± 24.36[c]	158	49.77 ± 4.60[c]
Third	403	95.34 ± 10.58[ab]	82.25 ± 20.19[a]	143	45.58 ± 2.67[d]

Means within the same column bearing different superscripts are significantly different ($p<0.05$).

Table (6): Heritability for hatch, 2wk, 4wk, and 6 weeks body weight in Japanese quails of three successive generations

	Heritability estimates			
Generation	**Hatch weight**	**Two week**	**Four week**	**Six week**
First	0.82	0.77	0.16	0.19
Second	0.82	0.90	*	0.21
Third	0.74	0.24	0.30	0.10

*= Meaningless values

Table (7): Heritability for Relative growth rate of three successive generations of Japanese quails

Generation	R 0-2	R 2-4	R 4-6	R 0-6
First	0.75	0.91	0.16	0.38
Second	0.91	0.61	0.82	0.23
Third	0.46	0.20	0.05	0.32

- R 0-2 (relative growth rate from hatch to two weeks).
- R 2-4 (relative growth rate from two to four weeks).
-R 4-6 (relative growth rate from four to six weeks).
-R 0-6 (relative growth rate from hatch to six weeks).

Table (8): Heritability for fertility and hatchability of base and three successive generations as well as heritability for age at sexual maturity of three successive generations.

Generation	Fertility	Hatchability	Age at sexual maturity
Base	N.E	0.06	-
First	0.01	0.15	0.44
Second	0.11	N.E	0.15
Third	N.E	0.16	0.07

N.E= non estimate

Table (9): Phenotypic correlation (above diagonal) and genetic correlation (below diagonal) for body weights at different ages in the first generation (diagonal is the heritability for the traits).

	0 wt	2 wt	4wt	6 wt
0 wt	**0.82**	0.18	0.20	0.15
2 wt	0.14	**0.77**	0.62	0.43
4 wt	0.53	0.54	**0.16**	0.65
6 wt	0.25	0.35	0.66	**0.19**

0 wt = the body weight at hatch
2 wt = the body weight at 2 weeks
4 wt = the body weight at 4weeks
6 wt = the body weight at 6weeks

Table (10): Phenotypic correlation (above diagonal) and genetic correlation (below diagonal) for body weights at different ages in the second generation (diagonal is the heritability for the traits).

	0 wt	2 wt	4wt	6 wt
0 wt	**0.82**	0.15	0.03	0.11
2 wt	0.09	**0.90**	0.86	0.50
4 wt	-0.02	0.97	*	0.53
6 wt	0.36	0.96	0.86	**0.21**

0 wt = the body weight at hatch
2 wt = the body weight at 2 weeks
4 wt = the body weight at 4weeks
6 wt = the body weight at 6weeks
* = Meaningless values

Table (11): Phenotypic correlation (above diagonal) and genetic correlation (below diagonal) for body weights at different ages in the third generation (diagonal is the heritability for the traits).

Weight	0 wt	2 wt	4wt	6 wt
0 wt	**0.74**	0.25	0.19	0.11
2 wt	0.21	**0.24**	0.84	0.48
4 wt	0.08	0.88	**0.30**	0.61
6 wt	0.17	0.68	0.61	**0.10**

0 wt = the body weight at hatch
2 wt = the body weight at 2 weeks
4 wt = the body weight at 4weeks
6 wt = the body weight at 6weeks

Table (12): Genetic and phenotypic correlations between age at sexual maturity and 6-week body weight for the three successive generations

Generation	r_g	r_p
First	0.65	-0.34
Second	-0.98	-0.03
Third	-0.84	-0.65

r_g= Genetic correlation
r_p= Phenotypic correlation

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الملخص العربى

التقديرات المظهرية والوراثية لبعض الصفات الانتاجية والتناسلية فى السمان اليابانى

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أجريت هذه الدراسه على عشيرة من السمان اليابانى وذلك لحساب المعاييرالوراثية والمظهرية لصفات النمو ونسبه الخصوبة والفقس وذلك لمده أربعة اجيال متتالية فى ظل الظروف البيئية المناسبة ،حيث كانت متوسطات وزن الجسم عند الفقس ٩,١٥، ٨,٧٢ ، ٨.٧٢ جم وعند اسبوعين ٤٣,١٨ ، ٥٧,١٣، ٦٢,٨٥جم وعند اربعة اسابيع ١١١,٠٦ ، ١٣٩,٣٧، ١٥٢,٢٦ جم وعند ستة اسابيع ١٨٦,٣٣، ٢٠٢,٩٥، ٢١٤,٧٢ جم وذلك للجيل الاول والثانى والثالث. وكانت قيمة المكافئ الوراثى لوزن الجسم عند الفقس، اسبوعين، أربعة أسابيع، ستة أسابيع تتراوح من ٠,٧٤ الى ٠,٨٢ و٠,٢٤ الى ٠,٩٠ و ٠,١٦ الى ٠,٣٠ ، و ٠,١٠ الى ٠,٢١ على الترتيب. وكانت قيمة المكافئ الوراثى منخفضة لنسبة الخصوبة والفقس .

كما كانت الارتباطات الوراثية والمظهرية بين وزن الجسم فى الأعمار مختلفة ايجابية خلال جميع الأجيال. كما اظهرت النتائج فروق معنوية لتاريخ التفريخ على وزن الجسم للأجيال المتعاقبة فضلا عن التاثير الواضح للجنس على وزن الجسم ، حيث كانت الإناث أعلى فى الوزن من الذكور فى الاجيال المتتالية . وأشارت النتائج أن تاثير الجيل كان واضحا لجميع الصفات المدروسة .

ونخلص من هذه النتائج أنه يمكن زيادة وزن الجسم للسمان اليابانى عن طريق الانتخاب المباشر لوزن الجسم الأعلى ، ومن ناحيه أخرى يمكن تحسين نسبة الخصوبة و الفقس من خلال تحسين الظروف البيئية المحيطة.