SHORT-TERM SELECTION FOR BODY WEIGHT AND GROWTH RATE IN JAPANESE QUAIL

1. DIRECT SELECTION RESPONSE

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ABSTRACT:

Three quail lines were used in this work to study the effects of mass selection for increased body weight or growth rate: HBW_{42} line was selected for high body weight at 42 day of age, HGR_{1-42} line was selected for high growth rate during the period from one-day to 42 day of age and randombred control line (RBC) was maintained as non-selected pedigreed population over three generations of selection. **The following results were obtained:**

There was an asymmetry in the direct response to selection in the male and female BW and GR favoring females. After three generations of mass selection, the HBW_{42} line exceeded the RBC by 8.40g (4.81%) and 13.66g (7.53%) for males and females, respectively. The regression coefficients were higher for females than males after the 3rd generation being 2.28g (1.295%) for females vs 0.475 g (0.315%) for males than the RBC. After three generations of mass selection, GR_{1-42} line decreased from 184.1 to 183.8% for males and 184.9 to 184.2% for females. Females had significantly higher response on generation number either as a deviation or as a percent deviation from the controls. The ratios of effective to the realized selection differentials for the selected lines and sex groups were more than unity, except for females in the 1st generation of selection for HGR_{1-42} line which was indicating that natural selection for fitness did operate in the opposite direction of artificial selection. The more than unity ratios in all sex groups of the HBW_{42} line and males of HGR_{1-42} line indicated that natural selection did not affect artificial selection. Selection yielded, with few exceptions, consistently lower heritability estimates in the selected lines, regardless of the estimation method. The unweighted mean of heritability estimates either for male or female progeny weights indicated that non-additive, primarily and maternal effects may be affected body weights. The larger h^2_S for females of HGR_{1-42} line in the 2nd and 3rd generations of selection than h^2_D indicated sex-linked effects. Females had considerably higher realized heritabilities than males. The realized heritabilities obtained for the HGR_{1-42} line were generally higher than those for the HBW_{42} line (0.69 vs 0.41). Generally, as generation number increased realized heritabilities for the selected traits in all sex groups decreased. The rate of decline in magnitude of heritabilities was higher in the HGR_{1-42} line than the HBW_{42} line. Whereas, the heritabilities of all sex groups for the RBC were higher than those for the selected lines. It can be concluded that the direct response for HBW_{42} line was greater than those of the line selected for HGR_{1-42} compared to their controls.

Key words: Short-term, selection, direct response, body weight, growth rate, Japanese quail.

INTRODUCTION

The goals in manipulating growth process in animals, which results from a complex interaction between genotype and environmental factors, are to improve productivity, productive efficiency and the quality of animal products **(Rahimi, 2005)**. Over the last six decades, meat-type chickens have been intensively selected for body weight gain **(Buyse *et al.*, 2001)**. Mass selection for body weight has resulted in significant reduction in the number of days required to grow bird to market weight. Frequently, however, response to selection falls off with time and continued selection may do little more than maintain a realized gain **(McCarthy and Siegel, 1983)**. Although selection programs are mainly concerned with increasing genetic gain, short-term progress should not be obtained at the expense of the within population genetic variability **(Loywyck *et al.*, 2005)**. In part, persistent selection decreases additive genetic variance, which is the basis of phenotypic response **(Marks, 1978)**. Limits to improvement may derive from the phenotypic response itself, which may establish opposing selection based on internal functional physiological relationships among components **(McCarthy and Siegel, 1983)**. However, during the last two decades, several livestock species, particularly meat-type chickens, have been intensively selected for improved growth rate, this has greatly reduced the time to reach the desired market weight **(Buyse *et al.*, 1991)**. Unfortunately, the increased growth rate has been accompanied by negative complications such as ascites, skeletal abnormalities and excessive fatness which is unproductive; moreover, consumer awareness of obesity or coronary heart disease have stimulated the demand for leaner meat **(Buyse *et al.*, 1991, Emmerson, 1997** and **Pakdel *et al.*, 2005)**. Growth is clearly a non-linear process **(Barbato, 1991)** and much of the literature uses the term 'selection for fast growth'. Few, if any, breeders truly selected for growth rate **(Decuypere *et al.*, 2003).** In fact, breeders generally select for body weight at a fixed age, regardless of the time frame of that age relative to the growth curve of the particular species **(Anthony *et al.*, 1991)**. Therefore, the present study was designed to estimate the direct response to selection for either high body weight or growth rate in Japanese quail over three generations of selection.

MATERIALS AND METHODS

The present study was conducted at the Poultry Research Center, Faculty of Agriculture, Fayoum University. It lasted for three generations after establishing the base population in order to estimate the response to selection. The base population was derived by randomly mating 61 sires each with two dams. No intentional selection was applied to any trait in the base population. Half-sib and full-sib matings were avoided. Three quail lines were originated from the base population. Line HBW_{42} was selected for high body weight at 42 days of age, line $HGR_{1\text{-}42}$ was selected for high growth rate during the period from one-day to 42 days of age and RBC line was maintained without selection for any trait as a randombred control. The selected and control lines were reared in the same battery but in separate decks from the selected lines throughout generations of selection. Each line was propagated by two hatches, one week apart, of approximately 300 quail using 30 sires each mated with two dams. Hatches were considered as replications. Individual mass phenotypic selection for both criteria of selection was carried out separately for each sex. The selection intensity of the present study varied from 0.66 to 1.45 for males and from 1.11 to 1.21 for females (the selected proportion ranged from 11.32 to 15.26% for males and from 22.00 to 28.17% for females) as shown in Table 1. However, values of selection differentials depend mainly on the available number of parents needed to renew the flock **(Falconer, 1989)**. The selected breeders were housed in breeding cages (one male and two females per cage) with sloping floor for collecting the eggs. The weekly produced eggs from each family (one sire and two dams according to their discrete colored, tinted botched egg shells) were incubated in an electronic incubators. The hatched chicks were pedigreed using wing bands. The quail chicks were visually sexed at 21 days of age. At five weeks of age, all birds were transferred to individual laying cages batteries. From hatch to six weeks of age, all quail were fed *ad libitum* a starter diet containing 24% CP and 2900 K cal/ME. From six weeks to the end of the study they were fed a breeder diet containing 20% CP, 2900 K cal/ME, 2.25% calcium and 0.43% available phosphorous was supplied. 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 **NRC (1994)** throughout the experimental duration. At the end of the 6th week of age, selection was done on the basis of the individual body weight at 42 days of age and growth rate during the period 1-42 days of age. All numbers of the birds, percent of selected parents and the selection intensity that used in the different generations for different lines in the present study are shown in Table 1. Body weights were recorded individually at 42 days of age (BW_{42}) to the nearest 0.01g. Growth rate during the period from 1-42 days of age ($GR_{1\text{-}42}$) was calculated according to **Brody (1945)** as follows:

$$\mathbf{GR = [W_2 - W_1 / {}^1/_2 (W_2 + W_1)] \times 100}$$

where: $\mathbf{W_1}$ **is** the weight at the beginning and $\mathbf{W_2}$ is the weight at the ending of the period**.**

Statistical analyses

For all generations, all percentage data were transformed to their corresponding angles and corrected for hatch effects before statistical analysis. According to **Becker (1985)**, data were computerized using the hierarchical analyses of variance and covariance procedure of **SAS (2000)** to compute the genetic parameters. The following random model was fitted for all studied traits to calculate the genetic parameters:

$$\mathbf{Y_{ijk} = \mu + S_i + D_{ij} + e_{ijk}}.$$

where**:** $\mathbf{Y_{ijk}}$ is the observation on the **ijk**th bird, **μ** is the overall mean, $\mathbf{S_i}$ is the effect of the **i**th sire, $\mathbf{D_{ij}}$ is the effect of the **j**th dam mated to the **i**th sire, and $\mathbf{e_{ijk}}$ is the random error. Heritability estimates were calculated according to **Becker(1985)** as follows:

$$\mathbf{h^2_S = 4\sigma^2_S / \sigma^2_S + \sigma^2_D + \sigma^2_W}$$

$$\mathbf{h^2_D = 4\sigma^2_D / \sigma^2_S + \sigma^2_D + \sigma^2_W}$$

$$\mathbf{h^2_{S+D} = 2\sigma^2_{S+D} / \sigma^2_S + \sigma^2_D + \sigma^2_W}$$

where: $\mathbf{\sigma^2_S}$ is the sire component of variance, $\mathbf{\sigma^2_D}$ is the dam component of variance and $\mathbf{\sigma^2_W}$ is the remainder of the genetic variance plus the environmental variance. Also, standard errors for heritabilites were calculated according to **Swiger *et al.* (1964)** as follows:

$$\mathbf{Var\ (\sigma^2_g) = 2/k2{*}\Sigma_g\ MS_g/f_g{+}2}$$

$$\mathbf{S.E\ (\sigma^2_g) = SQRT\ Var\ (\sigma^2_g)}$$

where: **K** is the coefficient of the variance component being estimated, $\mathbf{MS_g}$ is the gth mean square used to estimate the variance component, $\mathbf{f_g}$ is the degrees of freedom of the gth mean square.

Selection intensity, expected, realized and effective selection differentials and the expected, realized and cumulative values for direct responses in the present study were calculated according to **Falconer (1989)**. Also, one simple pairing t-test was used to compare all the realized and expected values for the responses to selection and the different pairing of selection differentials that used in this work. Direct responses (**G**) to selection were calculated according to **Falconer (1989)** as follows: $\mathbf{G = h^2\ i\ \delta_p}$ where: $\mathbf{h^2}$ is the heritability of the trait under selection, **i** is the selection intensity and $\mathbf{\delta_p}$ is the phenotypic standard deviation of the trait.

Realized heritabilites (Rh^2) were calculated in consequent generations of selection as follows: $\mathbf{Rh^2 = G/S}$ where: **G** is the direct response and **S** is the selection differential **(Singh and Kumar, 1994)**.

Table 1. The numbers of progeny, selected parents and selection intensity by line, generation and sex.

Line	G	All population (offspring)		Selected parents		% of selected parents		Selection intensity (Singh and Kumar, 1994)	
		M	F	M	F	M	F	M	F
HBW$_{42}$	0	227	220	32	64	14.10	29.10	1.13	1.25
	1	154	181	30	60	19.48	33.15	1.23	1.01
	2	164	181	20	40	12.20	22.10	1.98	1.37
	3	101	104	-	-	-	-	-	-
	Total	**646**	**686**	**82**	**164**	**15.26**	**28.17**	**1.45**	**1.21**
HGR$_{1-42}$	0	250	252	30	60	12.00	23.81	0.32	1.28
	1	244	264	25	50	10.25	18.94	0.82	0.76
	2	171	172	20	40	11.70	23.26	0.86	1.30
	3	121	117	-	-	-	-	-	-
	Total	**786**	**805**	**75**	**150**	**11.32**	**22.00**	**0.66**	**1.11**

HBW$_{42}$, HGR$_{1-42}$: selected lines for higher body weight and growth rate, respectively.
G: generation, M: male, F: female.

RESULTS AND DISCUSSION

Response to selection for the selected traits:

Generation effect:

Means of 42-day body weight and 1– 42 day growth rate for males and females of the selected and control lines are presented in Table 2. After three generations of selection, body weight increased from 171.40 to 183.07g for males and from 182.27 to 195.16g for females.

Growth rate during the period from 1 to 42 days of age decreased from 184.1 to 183.8% for males and from 184.9 to 184.2% for females after three generations of selection for HGR during that period. These results are in agreement with those recorded by **Abdel Fattah (2006).**

Sex effect:

Females were significantly ($P \leq 0.01$) heavier than males in the three generations either for the selected or the RBC lines (Table 2). The differences between females and males in body weights increased from 7.40g (3.98%) after the 1st generation to 12.09g (6.60%) after the 3rd generation. Birds in the RBC line showed similar trend, females body weights increased from 5.75 (3.22%) after the 1st generation to 11.77g (6.7%) in the 2nd generation whereas sex difference decreased to 6.83 (3.91%) in the 3rd generation. The regression coefficient of the deviations response to selection for HBW_{42} due to sex differences which favoring females on generation number was 2.35g (1.33%). Whereas, the regression coefficient for the RBC line means over the three generations was 0.54g (0.35%) which was not statistically significant and it was may be due to better management practices.

Females had significantly ($P \leq 0.01$) faster growth rate than males in the three generations for the selected and RBC lines as shown in Table 2. The differences between females and males in growth rate were consistent in the 1st and 2nd generations (0.80 and 0.80%, respectively) and then decreased in the third generation (0.40%) for the selected line. In the selected line as generation number increased, percent deviations decreased being 0.437, 0.435 and 0.218% for the 1st, 2nd and 3rd generation, respectively. However in the RBC line, deviation of females than males increased in the 2nd generation than in the 1st generation (0.60 vs 0.70%) and then decreased to 0.10 1 in the 3rd generation. Similarly, percent deviation for females than males decreased from 0.329 in the 1st to 0.40 in the 2nd generation and to 0.05% in the 3rd generation (Table 2), the same results are reported by **Abdel Fattah (2006).**

Line effect:

There were large variations in the different lines every generation. These were mainly environmental fluctuations and were corrected using the contemporary RBC line. Similar observations were reported by **Mukherjee and Friars (1970)** for turkey line selected for high growth rate and **El Gindy (1984)** for White Baladi chickens selected for high eight-week body weight. Responses to selection for 42-day body weight in the selected line are presented as deviation (g) and as a percent deviation from the RBC line (Table 3). After three generations of mass selection, the selected line for HBW_{42} exceeded the controls by 8.40g (4.81%) and 13.66g (7.53%) for males and females, respectively. The high response to selection is expected since selection to increase body weight has never been practiced in this population. The regression coefficients for 42-day body weight response on generation number for the selected line as a deviation and as a percent deviation from the controls are presented in Table 3. The regression coefficients were higher for females than males for the third generations 2.28g (1.295%) for females vs 0.475 g (0.315%) for males, for deviation and percent deviations from the RBC line. Smaller selection response for six-week body weight of 0.73g per generation was reported by **Piao *et al.* (2004).**

Table 2

After three generations of selection for HGR_{1-42}, females of the selected line exceeded those of the RBC line by 0.30 (0.163%). As generation number increased, growth rate decreased by -0.50 (-0.275 %) and -0.50 (-0.247%) for males and females, respectively, as a deviation ratio and as a percent deviation from the RBC line (Table 3).

Table 3. Response to selection for HBW_{42} and HGR_{1-42} as absolute or percent values deviations from the RBC line by generation in Japanese quail.

Line	Sex	Generations of selection						b	
		1		2		3			
		g	%	g	%	g	%	g	%
HBW_{42}	**Male**	7.45	4.18	8.51	4.90	8.40	4.81	0.475^{NS}	0.315^{NS}
	Female	9.10	4.94	6.45	3.48	13.66	7.53	2.28^{NS}	1.295^{NS}
		ratio	%	ratio	%	ratio	%	ratio	%
HGR_{1-42}	**Male**	1.00	0.549	0.40	0.218	0.00	0.000	-0.50^{NS}	-0.275^{NS}
	Female	1.20	0.657	0.50	0.272	0.30	0.163	-0.50^{NS}	-0.247^{NS}

HBW_{42}, HGR_{1-42}: selected lines for higher body weight and growth rate, respectively.

b: regression coefficient expected means estimate on generation number.

NS: not significant.

Selection differentials:

The expected, effective, actual (realized) and their selection differentials of the two selected traits (HBW_{42} and HGR_{1-42}) are shown in Table 4. The averages of the expected selection differential of HBW_{42} for males and females were 21.67 and 21.61g, respectively. Comparing the expected to effective selection differentials which indicated that natural selection did not have an influence during the three generations of artificial selection for high 42-day body weight. Differences between the expected and effective selection differentials either absolute or as a percent deviation from the RBC line for males and females were not statistically significant (Table 4). In respect of growth rate at 1-42 days, the same trend was found for both sexes. Differences in both selected lines between the responses of the males and females to selection were not constant throughout the generations. The overall of realized selection differentials, as absolute or as percent deviation from the RBC line indicated that the females by the third generation of selection for HBW_{42} had higher absolute deviations or percent, increase in body weight from the RBC line than the males (13.66 g and 7.53 % vs 8.40 g and 4.81 %, respectively) as shown in Table 4. Similarly, females had faster growth rates throughout generations than males either as an absolute deviations or as percent deviation from RBC averaging 0.017 and 0.908 % vs 0.005 and 0.274%, respectively) as shown in Table 4. The regression coefficients for responses on generation number for the selected lines as a deviation and as a percent deviation from the controls indicating insignificant increase of the different selection differentials from the first through the third generations of selection for HBW_{42}. However, the females of the HGR_{1-42} line showed significantly higher growth rate response on generation number either as a deviation or as a percent deviation from the controls as shown in Table 4.

Comparing the realized and expected selection differentials for the HBW_{42} trait in the selected line in each generation indicated significant absolute deviations from the RBC line for females, whereas all other comparisons were statistically insignificant for both sexes and lines either as absolute or as percent deviations as shown in Table 5. The realized selection differential for HBW_{42} trait had lower values than those of the expected or effective selection differentials for both males and females (Table 4). The differences in the HBW_{42} between the expected and realized unweighted mean selection differentials were 13.55 and 11.87g as a deviations and 7.72 and 6.40% as percent deviations from the RBC line for males and females, respectively. Similar trend of insignificant differences in HGR_{1-42} trait was shown by males of the HGR_{1-42} line. Therefore, natural selection has apparently exerted little influence on the response to selection for the two traits. Similar trends were cited by **Marks and Britton (1978), Marks (1981)** and **Omran (1993)**. However the realized selection differential for the HGR_{1-42} trait of females had higher deviation or percent deviation from the controls than the expected selection differences by 0.004 and 0.180 % (Table 4). The actual realized selection differentials includes the effect of artificial selection, while the effective or expected takes account the joint effect of artificial selection and a good part of natural selection as noted by **Falconer (1989)**. **Lerner (1954)** indicated that the ratio of effective to the realized selection differential provides a measure of association between fitness and body weight. The ratios of effective to the realized of selection differentials for both traits of sexes were higher than unity (Table 4) except for the HGR_{1-42} of females in the 1st generation of selection which was less than unity (0.75) indicating that natural selection for fitness did operate in the opposite direction of artificial selection. Otherwise, it indicated that natural selection did not affect artificial selection. The more than unity ratios in the lines and sex groups within each line indicated that natural selection did not affect artificial selection for HBW_{42} in all sex groups and males of the HGR_{1-42} line as shown in Table 4. **Falconer (1989)** suggested that, the differences between expected and the realized selection differentials may be due mainly to selected parents failing to produce an average number of offspring because of late sexual maturity and there may be differential fertility between different phenotypes by weight. The values of selection intensity for males and females for 42-day body weight averaged 1.45 and 1.37 and averaged 0.66 and 1.11 for these groups in the line selected for high 1-42 growth rate as shown in Table 1. In conclusion, females had higher realized selection differentials in the 1st and 3rd generations of selection for HBW, the cumulative realized selection differentials were 9.1 and 29.21g vs 7.45 and 24.35 g for females and males, respectively (Table 4). These results which indicating that females had larger selection differentials than males are in agreement with those reported by **Shebl *et al*. (1996), Shalan (1998), Bahie El Deen (2003)** and **Abdel Fattah (2006).**

Table 4

Table 5. Comparison between expected, effective and realized selection differentials for males and females in the two selected lines as a deviation or percent deviation from the random control (RBC) line.

T-test	Line	HBW_{42}		HGR_{1-42}	
	Sex	**g**	**%**	**g**	**%**
Comparison between expected and effective selection differentials	**Male**	٠.٤٩٠ ^{NS}	٠.٤٧٧ ^{NS}	٠.٠٧٥ ^{NS}	٠.٠٧٤ ^{NS}
	Female	٠.٨٨٧ ^{NS}	٠.٩٩٢ ^{NS}	٠.٠٨٧ ^{NS}	٠.١١٥ ^{NS}
Comparison between expected and realized selection differentials	**Male**	٠.٠٥٧ ^{NS}	٠.٠٥٨ ^{NS}	٠.٣٠٥ ^{NS}	٠.٣٠٦ ^{NS}
	Female	٠.٠٢٨*	٠.٠٦٥ ^{NS}	٠.٣٠٠ ^{NS}	٠.٢٩٨ ^{NS}
Comparison between effective and realized selection differentials	**Male**	٠.٠٦٧ ^{NS}	٠.٠٦٨ ^{NS}	٠.١٥٨ ^{NS}	٠.١٥٧ ^{NS}
	Female	٠.٠٢٠ ^{NS}	٠.٠٦٠ ^{NS}	٠.٣٥٣ ^{NS}	٠.٣٤٢ ^{NS}

HBW_{42}, HGR_{1-42}: selected lines for higher body weight and growth rate, respectively.

*: $P \leq 0.05$, NS: not significant.

Heritabilites of the selected traits:

Heritability estimates of 42-day body weight and 1-42 GR is presented in Table 6. The unweighted means of heritability estimates for the HBW_{42} line, were (0.24, 0.38 and 0.31 for males vs 0.22, 0.63 and 0.46 for females) as based on sire, dam and sire plus dam components, respectively. Selection yielded, with few exceptions, consistently lower heritability estimates in the selected line, regardless of the estimation method (Table 6). These results were lower than those estimated by **Bahie El Deen (1991 and 1994), El Fiky (1991), Sharaf (1992) and Farahat (1998).** Averages heritability estimates of 0.52, 0.62 and 0.44 based on S, D and S+D components of selected line for HBW_{42} were obtained by **Abdel Fattah (2001).** However, **Bahie El Deen (1999) and Saatci *et al.* (2002)** obtained lower estimates.

Heritability estimates based on S, D and S+D components of the RBC line were higher than those of the HBW_{42} line as illustrated in Table 6, this results confirms the theory that artificial selection for a certain trait reduces its genetic variance and consequently reduces its heritability estimates **(El Gindy, 1984)**. Heritability estimates based on female progeny weights were generally higher, with few exceptions, than those for male progeny weights as shown in Table 6. Similar results were cited by **Bahie El Deen (1991 and 1994), El Fiky (1991), Sharaf (1992 and 1994), Farahat (1998)** and **Abdel Fattah (2001 and 2006)**. The unweighted mean of heritability estimates either for male or female progeny weights indicated that the (h^2_D) being considerably larger than the (h^2_S) (Table 6). This may be due to non-additive, primarily, and maternal effects according to **Falconer (1989)**.

The sire component heritability estimates of GR_{1-42} for females in the 2nd and 3rd generations of selection tended to be considerably higher than those of the dam components (0.49 and 0.70 vs 0.07 and 0.27) as shown in Table 6. This may be due to the fact that selection intensity was much higher for males than females, indicating sex-linked effects. The dam component estimates for males were larger those for females. The unweighted mean of heritability estimates were 0.49 for males vs 0.28 for females. Similar trend was reported by **El Gindy (1984)** for White Baladi chickens.

Table 6

Realized heritabilities for body weight in the selected lines are presented in Table 6. The unweighted mean of the realized heritability for males and females in the HBW_{42} line were 0.399 and 0.446, respectively. However, in the second and third generations, the realized heritabilities for the selected females were lower than the estimated heritabilities, males in the third generation showed similar trend as shown in Table 6. **Marks and Britton (1978)** found higher estimate of realized heritability (0.61)**. Piao *et al.* (2004)** reported moderate realized heritability of six-week body weight during 66 to 78 generations of selection for small body weight. However, **Collins and Abplanalp (1965)** found lower unweighted average of 0.15 (ranging from 0.06 to 0.25) for realized heritability of six-week body weight. There were asymmetrical differences between the male and female values of realized heritability for both selected traits, females had considerable higher realized heritabilites than males. The unweighted means of females for realized heritabilities were higher: 0.446 and 0.851 vs 0.399 and 0.333 for males for HBW_{42} and HGR_{1-42}, respectively (Table 6).

The realized heritabilities obtained for the HGR_{1-42} in the present study were generally higher than those for the HBW_{42} line. The unweighted mean of realized heritability over generations of selection were larger for the HGR_{1-42} line than the HBW_{42} line (0.694 vs 0.409, Table 6). It can be seen that females had higher realized heritability values than males for the two selected traits. Generally, as generation number increased realized heritabilities for HGR_{1-42} trait of both males and females decreased (Table 6). Similar trends were reported by **Abdel Fattah (2006)**. On the contrary, opposite results were cited by **Metodiev and Drbohlav (1998)** that the realized heritability was higher for males than females (0.49 vs 0.36) at the 4th generation of mass selection for five–week body weight. However, **Suda *et al.* (2002)** found that the realized heritabilities increased in both males and females during two terms of 54 to 59 and 60 to 65 generations of selection for small body weight in Japanese quail.

In conclusion, the direct response for HBW_{42} line was greater than those of the line selected for HGR_{1-42} compared to their controls.

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الانتخاب على المدى القصير لزيادة وزن الجسم ومعدل النمو فى السمان اليابانى

١- الاستجابة المباشرة للانتخاب

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استخدمت فى هذه الدراسة ثلاثة خطوط من السمان وذلك لدراسة تأثيرات الانتخاب لزيادة كل من وزن الجسم ومعدل النمو وهى خط HBW_{42} المشتق بالانتخاب لوزن الجسم العالى عند عمر ٤٢ يوم و خط HGR_{1-42} المشتق بالانتخاب لمعدل النمو الأعلى خلال الفترة من ١ إلى ٤٢ يوم من العمر وخط RBC وهو خط المقارنة المنسب المحتفظ به دون إجراء اى نوع من الانتخاب عليه وذلك لمدة ٣ أجيال. **وتتلخص النتائج المتحصل عليها فيما يلي:**

كانت الاستجابة المباشرة للانتخاب سواء لوزن الجسم أو لمعدل النمو غير متجانسة مابين الإناث والذكور وكانت هذة الاستجابة لصالح الإناث. حيث تفوق بعد ثلاثة أجيال من الانتخاب الاجمالى خط HBW_{42} عن خط الكنترول بـ ٨.٤٠ جم (٤.٨١%) و ١٣.٦٦ جم (٧.٥٣%) لكلا من الذكور والإناث على التوالي حيث كانت الاستجابة العالية للانتخاب متوقعة طالما لم يسبق ممارسة اى انتخاب لزيادة وزن الجسم على العشيرة. وقد كانت معاملات الانحدار بعد الجيل الثالث أعلى للإناث عن الذكور فكانت ٢.٢٨ جم (١.٢٩٥%) للإناث مقابل ٠.٤٧٥ جم (٠.٣١٥%) للذكور مقارنة بخط الكنترول. بعد ثلاثة أجيال من الانتخاب الاجمالى لمعدل النمو العالى ،انخفض معدل النمو خلال الفترة من ١ إلى ٤٢ يوم من العمر من ١٨٤.١ إلى ١٨٣.٨ للذكور و١٨٤.٩ إلى ١٨٤.٢ للإناث و بدون فروق معنوية. كانت نسب الفوارق الانتخابية الموزونة إلى المحققة للخطوط المنتخبة ومجموعات الجنس أعلى من الواحد الصحيح فيما عدا الإناث فى الجيل الأول من الانتخاب لمعدل النمو العالى خلال الفترة من ١ إلى ٤٢ يوم من العمر وهو ما يشير إلى أن الانتخاب الطبيعى للموائمة كان يعمل فى عكس اتجاة الانتخاب الصناعى. كما أن زيادة النسبة عن الواحد الصحيح سواء فى مجموعات الخطوط أو الجنس داخل كل خط تشير إلى أن الانتخاب الطبيعى لم يكن له تأثيرا معنويا على الانتخاب الصناعى لكل مجموعات الجنس المختلفة لخط HBW_{42} و للذكور لخط HGR_{1-42}. مع بعض الاستثناءات القليلة فإن الانتخاب نتج عنه بصورة ثابتة حسابات عمق وراثى اقل للخطوط المنتخبة بغض النظر عن طريقة الحساب. حيث أشار متوسط حسابات العمق الوراثى سواء اعتمادا على أوزان نسل الأب أو نسل ألام إلى انه قد يكون هناك تأثيرا للتأثيرات الغير إضافية أو الأولية والأمية على أوزان الجسم. ولقد كانت حسابات العمق الوراثى اعتمادا على مكونات تباين الأب للإناث ومتوسط الجنسين بخط HGR_{1-42} فى الجيلين الثانى والثالث من الانتخاب أعلى من حسابات العمق الوراثى اعتمادا على مكونات تباين ألام مما يشير إلى وجود تأثيرات مرتبطة بالجنس. كانت الإناث لها عمق وراثى محقق أعلى من الذكور وعموما كان العمق الوراثى المحقق بخط HGR_{1-42} أعلى من العمق الوراثى المحقق بخط HBW_{42} (٠.٦٩ مقابل ٠.٤١) وبصفة عامة وجد انه بزيادة رقم جيل الانتخاب يقل العمق الوراثى للصفة المنتخبة فى كل مجموعات الجنس المختلفة ولقد وجد أن معدل الانخفاض فى قيمة العمق الوراثى يكون أعلى فى الخط الأول عن الخط الأخر فى حين أن العمق الوراثى لكل مجموعات الجنس المختلفة لخط RBC كان أعلى من مثيله فى الخطوط المنتخبة وهو ما قد يكون متوقعا نظرا لعدم تعرض هذا الخط لاى نوع من الانتخاب. ومن هذه النتائج يتضح أن الاستجابة المباشرة للانتخاب الاجمالى لزيادة وزن الجسم عند عمر ٤٢ يوم كانت أعلى من الانتخاب لمعدل النمو الأعلى خلال الفترة من ١ إلى ٤٢ يوم من العمر مقارنة بخط المقارنة (RBC).