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RESPONSE TO DIVERGENT SELECTION FOR 35-DAY BODYWEIGHT AND REALIZED HERITABILITIES OVER TWO GENERATIONS IN JAPANESE QUAILS

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ABSTRACT

Selection for high (H) and low (L) body weight (BW) at 35 days of age in Japanese quail was practiced for 2 generations. The base population was a random bred population obtained from the National Veterinary Research Institute in Jos, Nigeria. Realized heritability for BW at 35 day of age for H and L males in the 2nd generation was 0.43 and 0.35 respectively, while they were 0.50 and 0.55 (respectively) for the H and L females. Body weight of the 2nd generation H and L females were 118.64 and 45.44g respectively, and that of control is 82.96g. Similar weights for the males were 120.2, 47.43 and 78.64g for the H, L and C line respectively in the 2nd generation. The H and L lines diverged significantly (P< 0.05) in body weight at 35- days of age through the two generations of selection, while the control line was intermediate to the selected lines for bodyweight. The results indicate that the base population is amenable to improvement through selection.

***Key words**:* **body weight, high line, low line, control line, Japanese quails.**

INTRODUCTION

Artificial selection has been identified as one of the most effective tools for the genetic improvement of farm animals. Body weight in poultry is known to be moderately to highly heritable and hence the selection of heavier individuals should result in the genetic improvement of the trait (Oke *et al*.2004). Body weight has been found to increase over generation in birds selected for increased bodyweight in a long-term selection programme while the reverse has been reported in birds selected for decreased bodyweight (Aggrey *et al.,* 2003; Balcioglu *et al*., 2005; Darden and Marks 1988 and Marks, 1991). Several researches on influence of selection for body weight at various ages have been reported for Japanese quails in several countries other than the tropics (Balcioglu *et al*., 2005; Aggrey *et al.,* 2003; and Marks, 1991). There is dearth of records on the possible effect of selection for bodyweight in Japanese quail in the sub-Saharan environment. Available reports have shown the performance of the birds in this area to be lower than that of birds of the same breed reared in other places (Odunsi *et al*., 2008; Akpa *et al.* 2009 and). It is envisaged that improvement through divergent selection may help in the production of superior lines of quail, for use in egg and meat production in Nigeria.

As a preamble to actual selection for improvement, the present study was designed to examine whether and to what extent bodyweight of Japanese quail responds to divergent selection when birds are raised and managed in the sub-Saharan Savannah region of Nigeria. The response to divergent selection for bodyweight at 35 days of age was studied over two generations.

MATERIALS AND METHODS

A total of 1,500 day old random bred Japanese quails obtained from National Veterinary Research Institute (NVRI) Vom in Jos Plateau state of Nigeria served as the base population for this study. These birds were developed at the NVRI station from fertile eggs brought in from the Republic of Benin in 1992 with the help of the Directorate for Food Road and Rural Infrastructure (DFFRI) and have been maintained for more than a decade (Musa *et al.* 2008). Chicks were weighed on arrival and transferred into an electrically heated brooder pen at the animal pavillion unit of the department of animal production, University of Ilorin. All chicks received a starter ration of 24% crude proteins and 2700Kcal/kg of Metabolizable energy (Ojo and Ayorinde, 2009). At 35 days of age, birds were wing tagged, visually sexed by plumage colour as described previously (Musa *et al.* 2008) and weighed (g).

The base population consisted of 652 males and 679 females. High (H) and Low (L) 35 day body weight (BW) lines were established base on individual body weight at 35 days of age. Specifically, the H line consisted of all individuals birds having BW greater than one standard deviation above the population mean weight while all individuals which had body weight less than one standard deviation below the population mean were designated as the low line. A random sample of the base population was maintained as the control (C) line. After the lines were established, subsequent matings were made within line in the appropriate body weight direction. Approximately, selection was made from a population of 500 birds in generation one for the H line and a population of approximately 350 in the L line while selection in generation 2 was from a population of approximately 250 birds in the H line and 120 in the L weight line. The same rules of selection were applied in every generation. At maturity, birds in each group were mated on the floor at the ratio of 3 females to 1 male.

The response to selection (R) was determined as the deviation of the selected progeny mean from the mean of the parent generation (Falconer, 1970). The selection differential (S) was estimated as the difference between the mean of the selected population and the overall population. The realized heritability (h^2) for 35 day bodyweight were obtained for each generation by the formula (h^2 = R/S) using the controls to correct for systematic effects including inbreeding depression and environmental trends i.e. ratio of selection response to total selection differential. Significant differences among lines H, C and L for bodyweight were determined within each generation by one way analysis of variance using the SPSS software package. Significant differences among line means were separated by the Duncan's multiple range test (Duncan, 1955).

RESULT AND DISCUSSION

Table 1 shows the mean bodyweight (BW) with standard deviation (±SD) and the coefficient of variation for the random bred controls (C) and the selected populations. There was a general increase in mean 35day body weight in the high body weight selected populations while there were fluctuations in the mean BW of the C and the L weight group. Quails selected for high 35 days BW were significantly larger ($P<0.05$) than the control groups and those selected for lower BW in the two generations. One generation of selection in divergent directions resulted in highly significant differences between lines for the selected traits. These differences became progressively larger by the second filial generation. The H weight lines males and females were heavier by 72.77g and 73.20g than their L weight line counterparts. The control group was intermediate between the two divergently selected lines. For all the experimental lines, there was an initial increase in variability in BW with selection in the 1^{st} filial generation which resulted in higher coefficient of variation. However subsequent generation resulted in a decreased coefficient of variation in all the experimental lines and for both sexes. The males tended to be more uniform in BW than the females as reflected by the lower coefficient of variations in each generation.

The results of selection for BW were similar to those previously observed for Japanese quail (Marks, 1991; Nestor *et al*. 1982; Darden and Marks, 1988 and Balcioglu *et al*. 2005). The lower BW observed in this study than those reported by these authors could be as a result of differences in genetic sublineage and the environmental conditions under which the birds have been raised. Yet, the heritable improvement in 35 day BW in this study showed that response to selection is largely of genetic origin. The eventual decline in coefficient of variation also agrees with previous reports (Darden and Marks, 1988; Nestor *et al*., 1982) who reported that a decline of variance is expected as selection proceeds towards the limits.

Table 2 shows the selection differentials (S) by sex and experimental lines for 35 day BW. As a result of the fewer males selected, the selection differential of males in each generation were much higher than those of the females. Similar amounts of selection pressure within generations for both sexes were used to produce the H and L weight lines, therefore the selection differential were not quite different. However the smaller population size of the generation one (G1) L line resulted in a reduction in the selection differential. (Siegel, 1962).

Table 3 shows the result obtained for the realized heritability estimates by sex, generation and experimental lines. The C lines were used to correct for environmental fluctuations in the calculation of the realized heritability (h^2). The h^2 obtained in this study for male and female quails were slightly lower than earlier reports (Nestor *et al.* 1982; Darden and Marks, 1988). Heritability for males was higher in the 1^{st} generation but lower than that of females in the 2^{nd} generation. Combined estimates at the end of the 2^{nd} generations were however higher (0.44 and 0.46 for H and L lines respectively). The estimates obtained fall within the range of 0.30 0.55 reported by Darden and Marks, 1988. An increase in the heritability estimate in the 2^{nd} generation over the 1^{st} suggests that variation in bodyweight is much more due to genetic effect.

CONCLUSION

The result of this study shows that selection is directional and effective in the H and L lines. The intermediate value of the C line (between H and L) and its constancy between generations 0 and 2 also indicates that no genetic drift has occurred over the two generations. Selection is likely acting on heritable natural variation within the base population. Thus, suggesting that the base population is amenable to improvement through selection.

Table 1: Mean Body weights ± standard Deviation (SD) and coefficient of variation (%) at 35 days of age for Random bred controls and selected populations.

Generation	Males						Females					
	C	CV	H	CV	L	CV	C	CV	H	CV	L	CV
0	76.71[b] ±17.21	22.44	105.21[c] ±6.37	6.05	43.64[a] ±4.19	10.41	73.57[b] ±14.66	19.93	97.24[c] ±8.45	8.69	49.53[a] ±5.75	11.61
1	62.20[b] ±14.32	23.02	95.09[c] ±10.34	10.87	42.71[a] ±5.23	12.24	65.96[b] ±17.26	26.17	99.45[c] ±14.21	14.29	44.68[a] ±9.39	21.02
2	78.64[b] ±10.35	13.16	120.20[c] ±7.71	6.41	47.43[a] ±3.80	8.01	82.96[b] ±20.46	24.66	118.64[c] ±13.41	11.30	45.44[a] ±7.23	15.91

[a-c] Means in the same row with different superscript are significantly different ($P<0.05$). C- Control, H-High, L-Low.

Table 2: Selection Differentials for 35 days bodyweight in Two Generations of Male and Female Japanese Quail.

Generation	Sex	H	L	H L
0	M	30.90	30.67	0.23
	F	24.57	23.14	1.43
1	M	22.42	22.87	0.45
	F	28.78	21.37	7.41
2	M	24.26	26.88	2.62
	F	21.34	23.63	2.29

Table 3: Realized Heritability for 35 days Bodyweight in Two Generations of Male and Female Japanese Quail.

Generation	Sex	H	L
1	M	0.57	0.25
	F	0.20	0.06
	Combined	0.36	0.16
2	M	0.43	0.35
	F	0.50	0.55
	Combined	0.44	0.46

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