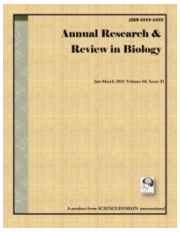

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Genetic Improvement for Body Weight of Japanese Quail

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Authors' contributions

Author SV designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author KK performed the farm work and collecting data. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: The small size of quail is a limited factor in many countries, because there is not a general consumption culture according to such products, so increase in the size of quail products is a necessity for such countries. In current study, selection for Japanese quail body weight at four weeks of age was performed at three generations to estimate the response to selection and realized heritability.
Study Design: Phenotypic selection
Place and Duration of Study: Animal research station of Razi University, Kermanshah, Iran, between February 2012 and November 2012.
Methodology: The selected line was chosen to increase body weight, and control line was maintained as a random-bred control. In each generation, 25 sires and 50 dams were used as parents for the next generation. Three generations of selection were performed and there were two hatches per generation. Genetic responses, realized heritability and slopes of cumulative genetic response were calculated.
Results: Results showed that response to selection and realized heritability for four week body weight after selection through three generations was 10.9 and 0.47 respectively. The mean of body weight in selected and control lines of last generation were 177.6 and 161.2, respectively. This is 10.2% cumulative genetic improvement. Results showed that genetic improvement in body weight were 4.7 and 6.2 for second and third generations, respectively.
Conclusion: this study demonstrates that 4wk body weight in Japanese quail has increased after three generation of selection and there was good genetic improvement for body weight.

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Keywords: Body weight; Japanese quail; realized heritability.

1. INTRODUCTION

Selection experiments provide the framework for the study of the inheritance of complex traits and allow the evaluation of theoretical predictions by testing observations against expectations. Depending on the time scale, the objectives of selection experiments may differ. Short-term experiment for example, can be used to estimate genetic variances and covariance test their consistency from different sources of information, and estimate the magnitude of the initial rates of response to selection. Long-term experiments are useful for measurement of changes in the rates of response or variances caused by the selection itself [1].

Around four decades ago, quail rendered as an animal model for researches, because of early sexual maturity, short generation interval, high rate of egg production, low maintenance cost associated with their small body size and their resistance to diseases [2,3]. Recently, quails have attained economic importance as food animal resources, which producing egg and meat that are enjoyed for their unique flavor [4]. Commercially-produced Japanese quail (*Coturnix coturnix Japonica*) are reared mainly for meat in Europe and for egg in Japan and are often bred as dual-purpose birds in other Asian countries [5]. Experimental researches indicated that Japanese quail responses quickly to selection for body weight [6,7,8]. The changes in carcass composition following 51 generations of selection for high 4 wk body weight in Japanese quail and concluded that body weights of selected line were significantly larger than body weight of control line at all ages with the greatest deviation occurring at the age of selection [7]. Mass selection for higher live body weight at 45 d old was effective in quail lines after 17 consecutive generations so that selected lines produced heavier carcasses and more meat [6]. Published estimates of heritability for body weight and growth rates in Japanese quail, from 2 wk of age through sexual maturity, averaged 0.40 in an unselected control population and in a population undergoing only short term selection for body weight [9]. Heritability 4 wk body weight for three strains of Japanese quail is 0.33, 0.43 and 0.46 [10]. A scientific report indicated that cumulative response to selection and realized heritability for females and males in high-weight line of Japanese quail were 26.04; 25.52 and 33.4%; 28.3%, respectively; it has been mentioned that effectiveness of phenotypic selection for body weight in Japanese quails [11]. Results of another experimental research indicated that after three generation selection for body weight in Japanese quail, cumulative genetic improvement was 17.3% or 5.8% improvement per generation and realized heritability was 0.55 [12]. The main purpose of current study was to estimate the genetic improvement and realized heritability after three generations selection to increase 4 wk body weight of Japanese quail.

2. METHODOLOGY

2.1 Birds

To establish two lines, a total of 150 birds were randomly sampled from the base population and divided equally in two lines. At next generations, the selected line was chosen for high weight measured at 28 days of age, and the control line was a random bred control. Quails were breed for three generations, and there were two hatches per generation. Each generation, was maintained with 50 families per line, produced by mating 25 sires and 50 females with 1:2 mating [75 birds (25 male and 50 female) for selected line, 75 birds (25

male and 50 female) for control line]. To mate the parents, two dams were placed at two-floor cages and one sire was mating with them every two days. Full-sib mating was avoided. Across each generation, the same parents were mated twice at one week intervals, to get two hatches of offspring. In two lines, eggs were collected daily. When chicken hatched, offspring in two lines were placed in two places, separately. In two lines, chicken were individually weighed at intervals at 1 and 28 d of age of each hatch. To generate the selected line, superior birds (50 dams and 25 sires) across two hatches were selected based on their high weight. The parents of control line were selected randomly from two hatches (50 dams and 25 sires). Three generations of selection were performed. All birds were fed as 24 % CP diet and 2900 kcal/kg ME from 1 to 28 days of age [13]. Water was available *ad libitum*.

2.2 Statistical Analysis

To evaluate genetic responses, realized heritability and slopes of cumulative genetic response were calculated; hence, line means in each generation were calculated. The calculation of line- and generation-specific means was done by the following model [14]:

$$Y_{ijkl} = \mu + L_i + G_j + H_k + e_{ijkl}$$

Where: Y_{ijkl} = observed trait; μ = overall mean; L_i = fixed effect of ith line; G_j = fixed effect of jth generation; H_k = fixed effect of k^{th} hatch; e_{ijkl} = random error term.

Two analyses were conducted using the line and generation-specific means. Firstly, realized heritability for body weight was calculated as a ratio of cumulative selection response to cumulative selection differential. Secondly, genetic response was quantified as a regression slope of generation means against increasing generation number [1].

3. RESULTS AND DISCUSSION

Response to selection for 4 wk body weight after selection for three generations was 10.9 (Table 1). The mean of body weight of selected and control lines at first and second generation was 160, 154.5 and 168.2, 158, respectively. The mean of body weight of selected and control lines at last generation were 177.6 and 161.2, respectively. It was 10.2% cumulative genetic improvement. Results showed that genetic improvement in body weight was 4.7 and 6.2 for second and third generations, respectively (Table 1). The results showed that realized heritability for 4 wk body weight after selection for three generations was 0.47 (Table 1).

Realized heritability is calculated as ratio of selection response to selection differential. Improvement of response to selection depends on selection intensity, selection accuracy and genetic variance; and optimal response to selection is obtained by maximizing these factors, but it is not simultaneously possible. In selection experimental, by increasing in allele's frequency for traits under selection, genetic variation is decreased, hence inbreeding is inevitable.

Short-term selection is often performed with high selection intensity and usually genetic improvement is high. It should be noted that the selection intensity is not the same in different generations, although number of replacements was equal per generation, but some

of them were died or couldn't lay, so they didn't have any contribution at next generation; furthermore, 75 replacements were selected per generation and it depends on how many birds have been at source of these replacements.

Different in response to selection on various experiments are due to different in selection intensity, selection accuracy and genetic variance at population under experiment.

After three generations of selection, a significant improvement in BW was made. In other words, the initial response to selection was acceptable. This initial high response is due to high selection accuracy, but this short-term increase, will be moderated because of inbreeding and Bulmer effect [15].

In this research, realized heritability for 4wk body weight after selection for three generations is in agreement with the results of other researchers [16,17,18,19] and differs with results from some researches [9,20]. Heritability for particular trait can take different values according to population, environmental condition surrounding the animal and calculation method [21]. Also, differences in heritability may be due to method of estimation, population genetic structure, environmental effects and sampling error from small data set or sample size [22].

Table 1. Selection response and realized heritability for 4 wk weight body

Generation	Population mean		Selected means [1]	Selection differential	Response		Response after correction
	S [2]	C [3]	S	S	S	C	S
0	154	154	-	-	-	-	-
1	160	154.5	170.2	10.2	-	-	-
2	168.2	158	181.2	13	8.2	3.5	4.7
3	177.6	161.2	-	-	9.4	3.2	6.2
sum	-	-	-	23.2	-	-	10.9
Realized heritability=10.9 / 23.2 = 0.47							

[1]Means of selected birds, [2]Selected line, [3]Control line

Linear mean for 4 wk body weight at different generations has been shown at Fig. 1. The results showed that, 4 wk body weight in Japanese quail has increased after three generation selection. There is a relatively improvement in body weight at control line (Fig. 1). Improvement in body weight at control line can be due to either improvement environmental conditions or natural selection.

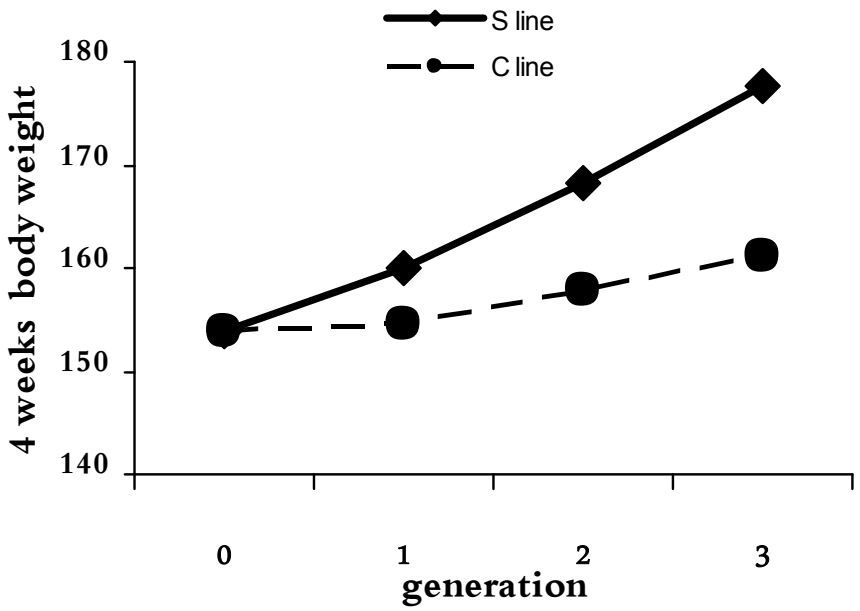

Fig. 1. Linear mean of 4 wk body weight in different generation

4. CONCLUSION

The small size of quail is a limited factor in many countries, because there is not a general consumption culture according to such products. So increase in the size of quail products is a necessity for such countries. Experimental researches indicated that Japanese quail responds quickly to selection for body weight [9,15]. Overall, this study demonstrates that 4wk body weight in Japanese quail has increased after three generation of selection and there was good genetic improvement for body weight.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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