The Journal of Animal & Plant Sciences, 24(3): 2014, Page: 869-873
ISSN: 1018-7081

SELECTION FOR HIGHER THREE WEEK BODY WEIGHT IN JAPANESE QUAIL:2. ESTIMATION OF GENETIC PARAMETERS

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ABSTRACT

Data on pedigree and performance records of 480 Japanese quails progeny of 81 sires and 200 dams maintained at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore selected for three generations for higher body weight were used to estimate some genetic parameters for body weight, egg production performance, egg quality and hatching traits. The generation, sex and genetic groups were included as fixed effects in the model for univariate analysis through WOMBAT computer software for Restricted Maximum Likelihood (REML) procedure. The heritability estimates of body weight at the age of 3rd, 4th and 6th weeks were 0.0126, 0.0315 and 0.20, respectively. For egg production traits including age at 1st egg, total eggs produced and average feed consumed per egg, heritability estimates were 0.20, 0.20 and 0.0047, respectively. Whereas for fertility and clear eggs %, heritability estimates were almost negligible indicating the impact of environment more pronounced than genetics on hatching traits. Breeding values for growth performance in selected birds at the age of three weeks ranged between, -0.1845 to 0.4102, -0.2309 to 0.471 and -0.0908 to 0.5373 in generation 1, 2 and 3, respectively. For random-bred control birds the values ranged between -0.845 to 0.6384, -1.2542 to 0.6713 and -1.3781 to 0.7623 for 1st, 2nd and 3rd generation, respectively. Genetic trend lines indicated positive response to selection as the generations progressed.

Key words: - Japanese quail, selection, body weight, heritability, breeding values, genetic trend.

INTRODUCTION

Declaration of Japanese quail as a model experimental bird for avian research (Minvielle, 2004) at the event of World Poultry Congress 2004 (Istanbul, Turkey) has attracted a number of scientists all over the world to work on this blessed specie. It has a well-recognized history for its use as a meat and egg production source in different parts of world. In quail, as in other species of poultry, great attention has been paid to study the effects of selection for body weight, growth patterns and reproductive efficiency (Anthony *et al.,* 1990; Anthony *et al.,* 1996; Marks 1979, 1991). Japanese quail respond quickly to selection for body weight (Caron *et al.,* 1990; Nestor and Bacon, 1982). Body weight and carcass traits are under intensive selection for more than half a century, and are considered as the most important economic traits in broiler breeding programs (Nassar *et al.,* 2012). Body weight and body weight gain are affected by genetic and non-genetic factors such as year and season of production, sex, nutrition, adaptability, climatic conditions and management (Hafez, 1963).

In order to have success through selection for a particular trait or a set of traits proper knowledge of genetic parameters is the most important. Without this information it is unclear whether selection strategies are needed at all and what the expected response to selection could be. Furthermore, most applied breeding programs make use of best linear unbiased prediction (BLUP) for the estimation of breeding values, which require knowledge of genetic parameters such as direct genetic variance, covariance between direct and social effects and the additive gene effects (Bijma *et al.,* 2007; Hocking, 2009; Muir, 2005). Falconer (1960) reported that heritability and repeatability of under observation traits as well as their genetic and phenotypic correlations generally cover the term genetic parameters. The study of genetic trend allows the visualization of the efficiency of the selection procedures and the quantification of the genetic changes of the traits under selection over the time, besides the possibility of correcting eventual mistakes in the direction of selection (Van Melis *et al.,* 2001). The follow-up and the interpretation of genetic trend estimates allows monitoring the efficiency of improvement strategies and assures that the selection pressure is directed towards the traits of economic importance, besides assisting in the definition of the selection objectives. The genetic and environmental variation is described by the genetic parameters and might vary among populations and environments and that's why it should be estimated in different populations and environments (Khaldari *et al.,* 2010). The present study was therefore conducted with the objectives to estimate genetic parameters for growth, egg production, egg quality as well as hatching traits in Japanese quail being selected for higher three week body weight.

MATERIALS AND METHODS

The experiment was conducted at Avian Research and Training (ART) Centre, University of Veterinary and Animal Sciences, Lahore, in order to estimate some genetic parameters of Japanese quail as a response to selection for higher three week body weight. The univariate analysis of different traits included generation, sex and genetic group as fixed effects. Records of 480 animals with 81 sires and 200 dams were used for this purpose through WOMBAT computer software. A base population of 1080 day old quail chicks was procured from the hatchery at ART Center. These chicks were equally divided into two groups (Selected and Random bred) having 60 replicates each comprising 9 birds/replicate. At the age of 21 days, each bird was weighed and in selected (S) group only 20 males and 60 females having the highest body weight were picked to be the parents of next generation, while in random-bred (RBC) group, 20 males and 60 females were randomly picked and reared further to be the parents of next generation. RBC group was maintained as a control to neutralize the effect of environment on birds' performance. In both the groups, all pedigree records were maintained and next mating groups (families having 1 male and 3 female) were constituted in such a way that there were minimum chances of inbreeding. At the age of five weeks, these birds were shifted to the breeding house and at the age of 16 weeks, eggs collected for the last three weeks were set in the incubators in order to obtain day-old chicks. 540 chicks were hatched from selected group and 493 from RBC group in the next generation. These chicks were again reared for 21 days. In case of selected group at the age of 21 days, birds with the highest body weight (60 females and 20 males) were selected to be the parents of next generations, while, in case of RBC group birds were picked randomly avoiding any selection (60 females and 20 males). At the age of 16 weeks, the eggs were again set and after 17 days, 550 chicks were procured from the birds of S group and 507 from RBC group. These chicks were further reared till 21 days, weighed and selected to be the parents of next generation.

Management and housing: All the experimental birds were maintained in cages specially made for separate rearing and breeding. The eggs were incubated in an Italian Machine (Victoria) having separate arrangements for setting and hatching of eggs. The chicks were housed in multi deck cages and placed in one of the well ventilated octagonal shape quail house measuring (33×12×9 ft). Fresh and clean drinking water was provided through automatic nipple drinkers. The broiler chicks were fed quail ration *ad-libitum* formulated according to NRC standards (1994), especially for quail broiler (CP 24% and ME 2900 K Cal/Kg), while breeders were fed measured quantity of feed (CP 20% and ME 2900 K Cal/Kg) prepared as per NRC (1994).

Genetic Parameters Estimation: The univariate analysis for body weight at the age of 3rd, 4th , 6th , 14th and 20th week along with some egg production, hatching and egg quality traits was performed considering generation, sex and genetic group (selected or random bred) as fixed effects. WOMBAT computer package especially designed for estimating variance components was used to calculate heritability estimates for growth, egg production, egg quality and hatching traits. This software also generates estimated breeding values (EBVs) as a by-product; the estimated breeding values for 3rd, 4th, 10th, 14th and 20th week body weight were plotted for exhibiting genetic trends.

RESULTS AND DISCUSSION

Heritability estimates for growth traits: The heritability estimates for the body weight at the age of three, four, six, fourteen and twenty weeks were 0.0126, 0.0315, 0.200, 0.200 and 0.200 respectively. In comparison to the results of the present study in most of the other studies relatively higher estimates of heritability for three week body weight were observed as 0.18, 0.43 and 0.58 by a number of scientists (Akbas *et al*., 2004; Resende *et al.*, 2005; Saatci *et al.,* 2006). For four week body weight variable heritability estimates were recorded by a number of scientists as 0.22, 0.47, 0.19, 0.47 and 0.61 by Varkoohi *et al.* (2011); Abdullah *et al.* (2011); Saatci *et al.* (2006); Resende *et al.* (2006); Akbas *et al.* (2004), respectively. For six week body weight Saatci *et al.* (2006) and Akbas *et al.* (2004) reported the heritability estimates as 0.15 and 0.44, respectively. The heritability estimates in the present study fall between lower to medium range. These lower values might be due to mass selection for a number of generations in the last 08 years without any controlled breeding and maintenance of pedigree records in the flock under study. Continuous mass selection might have decreased additive genetic variance in the population and the other reason might be small data set involving less number of birds in three generations. Mehrgardi (2012) and Marks (2012) also estimated lower heritability values in advanced generations of Japanese quail being selected for higher four week body weight depicting a decrease in additive genetic variance as the generations progressed in long term selection experiments.

Heritability estimates for egg production traits: For different egg production traits (age at 1st egg, 1st egg weight, average daily feed intake and the total egg number for six to 14 weeks of age) the heritability estimate was 0.20. For age at 1st egg comparatively higher heritability estimates were recorded as 0.53, 0.53, 0.42 and 0.55 respectively (Andre *et al.*, 2011; Savegnago *et al.*, 2011; Lwelamira *et al.*, 2009; Khalil *et al.*, 2004). Variable heritability estimates were reported by a number of scientists regarding egg weight. Andre *et al.* (2011); Saatci *et al.* (2006); Veronica *et al.* (2002); Minvielle (1998); Wei and van der Werf (1995) recorded the heritability estimates 0.31, .25, 0.54, 0.49, and 0.52 to 0.91, respectively for egg weight. For average feed per egg, the heritability estimate was 0.0047. Lindsay *et al.* (2012) reported the heritability estimate as 0.16 for the above trait and Sakunthala *et al.* (2009) also reported the heritability estimates as 0.02 to 0.59 for average feed per egg. Lower heritability values in the present study might be due to decrease in additive genetic variance owing to mass selection for a number of generations without any pedigree or sib records.

Heritability estimates for egg quality and hatching traits: As expected heritability estimates for fourteen week egg weight, egg shell thickness, yolk index and haugh unit value were negligible. In Japanese quail regarding egg weight at the age of 14 weeks no estimates of heritability were reviewed earlier. Regarding shell thickness higher estimates of heritability were reported by Lwelamira *et al.* (2009) and Metin (2007) as 0.53. No estimate was reported regarding yolk index and haugh unit value in earlier studies in Japanese quail. The heritability estimate for hatchability % in the present experiment was also zero indicating the traits were not under the influence of additive gene action while the heritability estimate for clear/infertile eggs %, as well as dead germ and dead in germ % was 0.0315, Hatchability %, dead in shell and dead germ% are the traits influenced by a number of factors and estimates for heritability are on lower side. The same is the case with heritability estimates of hatching traits in the present study. Magda *et al.* (2010); Helal (1999); Sharaf (1992); Mitchell *et al.* (1977) also reported lower to moderate heritability estimates for hatchability% as 0.16, 0.12, 0.11 and 0.32, respectively. The differences in the heritability estimates can be attributed to the method of estimation, population sample size and environmental effects (Metin, 2007).

Estimation of Breeding values and genetic trend for weekly body weight: The breeding values were generated as a by-product while calculating the heritability estimates. These breeding values for body weight at different ages were plotted to observe the genetic trend in different generations. These breeding values were separately plotted for random-bred and selected populations. In selected populations a linear increasing trend was observed as the generations progressed while in case of random bred population the situation got reverse with a linear decreasing trend starting from generation 1 till generation 3 (Figure 1-5). An increasing trend in the selected populations depicted the effectiveness of selection for increasing three week body weight. Grosso *et al.* (2009) also observed positive trends in a commercial broiler line selected for higher body weights regarding absolute carcass weight.

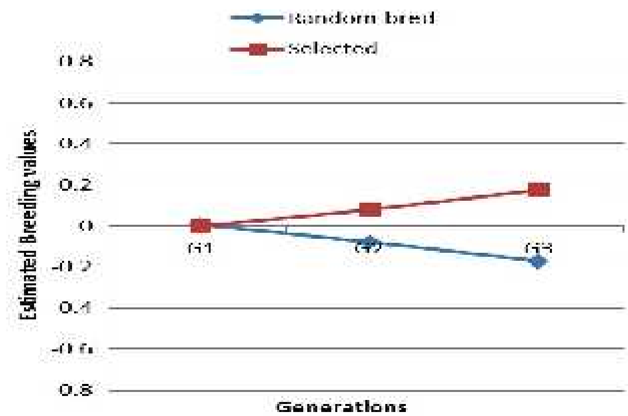

Figure 1. Genetic Trend for Three Week Body Weight

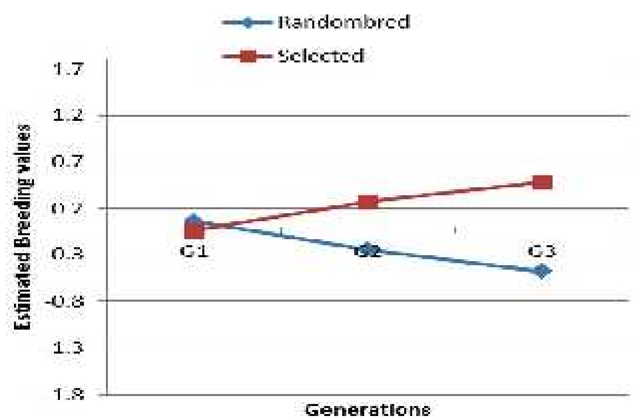

Figure 2. Genetic Trend for Four Week Body Weight

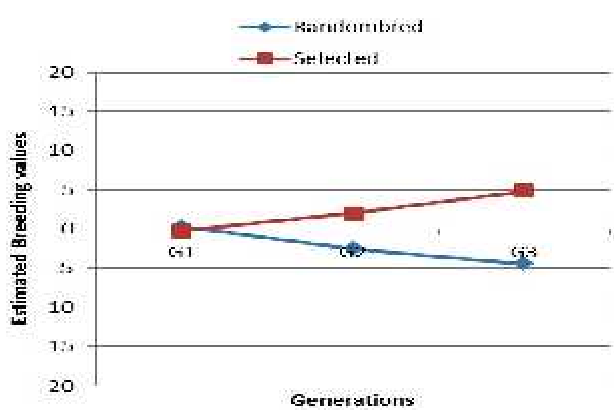

Figure 3. Genetic Trend for Ten Week Body Weight

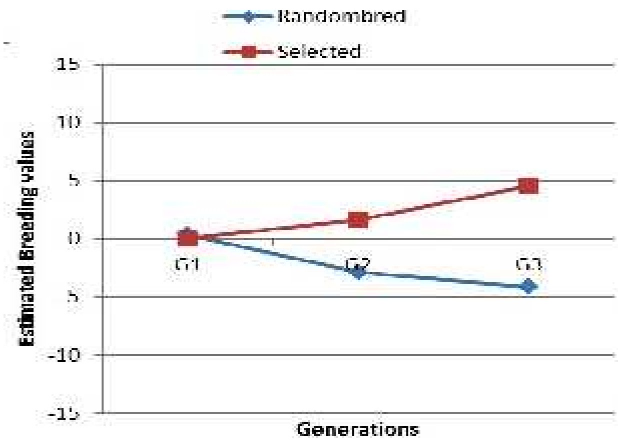

Figure 4. Genetic Trend for Fourteen Week Body Weight

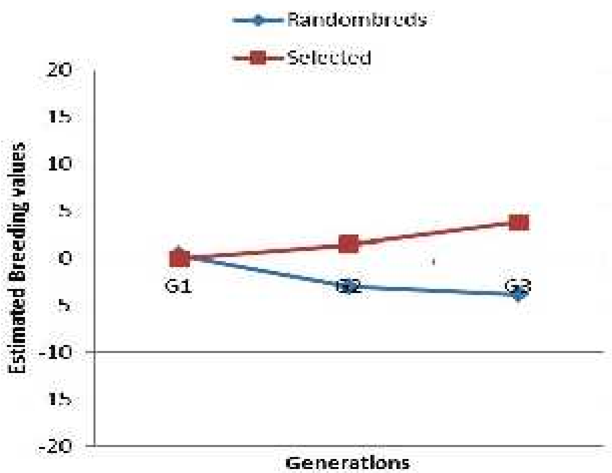

Figure 5. Genetic Trend for Twenty Week Body Weight

Conclusions: Comparatively lower heritability estimates for certain traits observed in the present study might be attributed to the consequent effect of earlier selection procedures (mass selection) and different techniques applied for their estimation. Population size and environmental factors may also be contributing factors. The positive trend for growth traits in selected populations at different ages proved selection to be effective and helpful in increasing three week body weight in Japanese quail.

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