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Research Article

EVALUATION OF GROWTH TRAITS IN SHORT TERM SELECTION FOR DIFFERENT AGES IN JAPANESE QUAIL

*** A. Ashok and R. Prabakaran**
Department of Poultry Science, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India
Present address: [1]Institute of Food and Dairy Technology, Tamilnadu Veterinary and Animal Sciences University, Koduvalli, Alamathi Post, Chennai, Tamilnadu, India.
[2]Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamilnadu, India
**Author for Correspondence*

ABSTRACT
Meat type Japanese quail were subjected to three different methods of individual phenotypic selection *viz.*, high two week body weight, four week body weight and high four week body weight coupled with low relative body weight gain between 4-6 weeks of age. Selection was carried out for three generations and the respective populations were designated as Line selected for high two week body weight (SWL), Line selected for high four week body weight (FWL), Line selected for high four week body weight and low relative weight gain between 4-6 weeks of age (LWL) lines and a control line (COL) was also maintained without adopting any selection with random pairing. The over all least squares means for body weights were 8.42 ± 0.04,39.63 ± 0.25, 79.30± 0.51, 120.84±0.63, 154.93±0.72, 177.80±0.75 and 196.85±0.89 g at hatch, 1,2,3,4,5, and 6 weeks of age, respectively. The least squares means of body weights ranged from 8.60±0.04 g at hatch to 197.04±0.99 g at 6 weeks of age in SWL line, 8.43±0.04 g to 199.87± 0.97g in FWL line and 8.30±0.04 g to 196.31±1.02 g in LWL line. In COL, the means body weights varied from 8.36±0.04 g at hatch to 194.17± 1.03 g at six weeks of age. The least squares means of selected parents at two weeks of age (SWL) was 83.32±0.78 g, at four weeks of age (FWL) 166.99 ± 1.46 g and at six weeks of age (LWL) 203.33± 0.94 g. Selected lines had significantly ($P<0.05$) higher body weights than the control line at all ages and the same steadily improved over subsequent generations indicating positive direct and correlated responses irrespective of the method or age at selection.

***Key Words*:** *Japanese Quail- Selection- Body Weights*

INTRODUCTION
The Japanese quail, *Coturnix japonica* is known to have been domesticated since the 12th century AD in Japan, mainly for its ability to sing. Intensive production of the species started in Japan in the 1920s. The first egg lines were then developed by selection (Wakasugi, 1984). They were successfully introduced from Japan to America, Europe, the Near and Middle East between the 1930s and 1950s, where specific lines were bred for egg and meat production. Extensive research on C*oturnix japonica* has showed that it was a valuable animal for avian research (Woodard *et al.*, 1973). It has expanded from avian science-related topics to biology and medicine, as this bird could be kept easily in relatively large numbers in a small facility and be used as a model animal for a wide variety of work, from embryology (Le Douarin *et al.*, 1969) to space-related sciences (Orban *et al.*, 1999).
Growth is moderately to highly heritable and can be rapidly improved through individual phenotypic selection. However, growth is a dynamic process that involves both an increase in mass and synchronous differentiation and maturation of many tissues**.** Consequently, selection results are highly dependent on the methods employed, including the age of primary selection, intensity of selection, selection emphasis placed on correlated traits and the environment (including nutritional aspects) under which selection is exercised (Emmerson, 1997). A selection experiment was designed. Individual phenotypic selection was contemplated to facilitate development of superior breeder flock suitable for production of optimum number of fast growing commercial meat type Japanese quails. The study was also designed to obtain an

understanding of the relationship between selection age and growth with the following objectives, viz., to evaluate selection for juvenile, fourth-week and sixth-week body weights in Japanese quail.

MATERIALS AND METHODS

The study was carried out at the Institute of Poultry Production and Management, formerly known as Poultry Research Station, Tamilnadu Veterinary and Animal Sciences University, Nandanam, Chennai, India. A Japanese quail (*Coturnix japonica)* population, maintained at the institute formed the base population for this study. The foundation stock for the three selected and an unselected control populations was from a random mating Japanese quail line maintained at the Institute of Poultry Production and Management, Chennai. The line had no known history of artificial selection except for a short period during 1989 to 1992 when the population was subjected to selection on the basis of body weight at four weeks of age for four generations under two different nutritional environments of high and low protein diets. From the foundation stock, one hundred and eighty males and equal number of females were randomly selected, wing banded, weighed, and randomly assigned to four groups to have 45 pairs in each of the four groups. The breeder males and females were maintained in cages under single pair mating. Hatching eggs were collected and set for hatch. Chicks hatched from three groups were subjected to individual phenotypic selection for body weight at different ages. One group (SWL) was selected for high body weight at two weeks of age, the other (FWL) for high body weight at four weeks of age. The third group (LWL) was subjected to two stage selection with the initial selection practised at four weeks of age for high body weight, followed by selection for low relative body weight gain between four to six weeks of age. The fourth group (COL) was maintained as control line with random selection of parents.

The number of hatches obtained and the total number of progenies produced in the three selected lines and control were 2176, 1780, 2331 and 2343, respectively in S_0, S_1, S_2 and S_3 generations. Only those data of progenies with intact wing bands and whose sexes were phenotypicaly identifiable were included in the study. One of the four groups formed in the base generation (S_o) was treated as control line and raised separately along with the selected populations (other three lines) in each generation to observe and account for environmental influences. Single pair mating was followed with females assigned at random to individual males with the restriction that no full sib mating was permitted.

Measurement of the traits

Body weights at different ages: The body weights from hatch to six weeks of age were recorded at weekly intervals by using a digital weighing balance with an accuracy of 0.1 g for body weight at hatch (BWH) and 1 g for body weights from one to six weeks of age (BW1-BW6).

Statistical analysis: The data generated on body weight for age were corrected for the fixed effects of line, generation, sex and hatch by the least squares analysis (Harvey, 1979) using the following linear model based on pooled data.

$$Y_{ijklm} = \mu+st_i+g_j+s_k+h_l+e_{ijklm}$$

Where,

Y_{ijklm} = measurement of a trait on m^{th} bird belonging to l^{th} hatch, k^{th} sex, j^{th} generation and i^{th} line

μ = overall mean

st_i = effect of i^{th} line

g_j = effect of j^{th} generation

s_k = effect of the k^{th} sex

h_l = effect of l^{th} hatch

e_{ijklm} = random error, assumed to be distributed normally and independently with mean zero and variance σ^2

Duncan's multiple range test (Duncan, 1955) was employed to make all pair wise comparisons of means.

RESULTS AND DISCUSSION

Individual phenotypic selection for body weight was carried out in Japanese quail at three different ages for three generations. Mean performance of bird under the three modes of selection viz., high body weight at two weeks of age (SWL), at four weeks of age (FWL) and the third group based on high body weight at four weeks coupled with low relative weight gain between 4-6 weeks of age (LWL) along with the control (COL) on economic traits such as body weight and weight gain at different ages are presented here.

Results of the least squares analysis of variance of body weights based on pooled data are presented in Table 1 and corresponding least squares means are given in Table 2.

The over all least squares means for body weights were 8.42 ± 0.04,39.63 ± 0.25, 79.30± 0.51, 120.84±0.63, 154.93±0.72, 177.80±0.75 and 196.85±0.89 g at hatch, 1,2,3,4,5, and 6 weeks of age, respectively. The least squares means of body weights ranged from 8.60±0.04 g at hatch to 197.04±0.99 g at 6 weeks of age in SWL line, 8.43±0.04 g to 199.87± 0.97g in FWL line and 8.30±0.04 g to 196.31±1.02 g in LWL line. In COL, the means body weights varied from 8.36±0.04 g at hatch to 194.17± 1.03 g at six weeks of age. The least squares means of selected parents at two weeks of age (SWL) was 83.32±0.78 g, at four weeks of age (FWL) 166.99 ± 1.46 g and at six weeks of age (LWL) 203.33± 0.94 g.

Table: 1 Least squares analysis of variance for body weights

	Lines		Generations			Sexes		Hatches		Error
	df	**M.S.S**	**d.f**	**M.S.S**	**d.f**	**M.S.S**	**d.f**	**M.S.S**	**d.f**	**M.S.S**
BWH	3	27.49**	3	217.05**	1	1.68	5	49.79**	6532	0.83**
BW1	3	491.47**	3	2623.98**	1	628.54**	5	32479.74**	6528	38.65**
BW2	3	5939.19**	3	8473.43**	1	4545.33**	5	23994.88**	6540	189.36**
BW2£			3	158.88*	1	296.51*	4	3015.94**	351	57.33**
BW3	3	3026.94**	3	83466.30**	1	29403.57**	5	51190.63**	6517	243.03**
BW4	3	1746.78**	3	142152.50**	1	109539.17**	5	9900.86**	6490	308.86**
BW4£			3	10358.48**	1	5334.86**	5	700.69**	350	140.88**
BW5	3	5300.41**	3	67635.02**	1	390358.30**	5	5309.68**	6213	326.08**
BW6	3	7264.24**	3	54355.53**	1	1007416.17**	5	6603.82**	5586	400.21**
BW6£			3	10183.43**	1	48321.08**	3	2997.06**	352	264.72**

**Significant at P<0.05; ** Significant at P< 0.01*

Results of the study carried out through individual phenotypic selection for body weights at different ages in the Japanese quail are discussed here in the light of the findings available in the literature to arrive at definitive inferences.

Least squares mean of body weight at hatch (BWH) of Japanese quail was 8.42 ± 0.04 g which was higher than the most of the values reported in the literature (Narayan, 1977; Chidananda *et al.*, 1985; Prabakaran, 1992; Cerit and Altinel, 1998 and Dhaliwal *et al*., 2004). While, Kocak *et al*. (1995) and Feroz Mohammed (2004) reported almost comparable weight at hatch, Punya Kumari (2007) obtained higher weight of 9.75 g in a selected line.

Least squares mean of body weight at two weeks of age (BW2) was 79.30 ± 0.51 g. All authors reviewed had reported much lower weight at the above age (Sefton and Siegel, 1974, Panda *et al*., 1980, Sachdev *et al*., 1988, Ashok, 1996, Brah *et al*., 1997, Dhaliwal *et al*., 2004, Feroz Mohammed, 2004 and Punya Kumari, 2007) barring Aggrey and Cheng (1994) who obtained 82.30 g.

Least squares mean of body weight at four weeks of age in the study was 154.93 ±0.72 g. Prakash Babu *et al*. (1980), Arjun Kumar *et al*. (1990), Praharaj *et al*. (1990), Shrivastava *et al*. (1995) and Shokoohmand *et al.* (2007) reported lower body weights at the same age. Marks (1996), Dhaliwal *et al*. (2004) and Punya Kumari (2007) were the few authors who obtained higher body weights at four weeks of age in selected lines.

Table: 2 Least squares means of body weights (g) at various ages (0-6 weeks) on pooled data

	BWH			BW1			BW2			BW2£			BW3		
	n	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Overall	**6545**	**8.42**	**0.04**	**6541**	**39.63**	**0.25**	**6541**	**79.30**	**0.51**	**-**	**-**	**-**	**6530**	**120.84**	**0.63**
Line															
SWL	1690	8.60^{a}	0.04	1689	39.88^{a}	0.28	1689	77.55^{c}	0.57	360	83.82	0.78	1686	119.50^{c}	0.71
FWL	1565	8.43^{b}	0.04	1565	40.18^{a}	0.27	1565	81.75^{a}	0.55	-	-	-	1558	122.56^{a}	0.68
LWL	1717	8.30^{c}	0.04	1716	38.90^{b}	0.29	1716	78.00^{c}	0.59	-	-	-	1716	121.33^{b}	0.72
COL	1573	8.36^{c}	0.04	1571	39.55^{c}	0.29	1571	79.91^{b}	0.60	-	-	-	1570	119.99^{bc}	0.73

	BW4			BW4£			BW5			BW6			BW6£		
	n	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
	6503	**154.93**	**0.72**	**-**	**-**	**-**	**6226**	**177.80**	**0.75**	**5599**	**196.85**	**0.89**			
Line															
SWL	1684	154.78^{b}	0.81	-	-	-	1650	177.71^{b}	0.84	1477	197.04^{b}	0.99	-	-	-
FWL	1546	156.34^{a}	0.78	360	166.99	1.46	1472	180.26^{a}	0.82	1309	199.87^{a}	0.97	-	-	-
LWL	1711	154.85^{a}	0.83	-	-	-	1626	177.64^{b}	0.87	1459	196.31^{b}	1.02	360	203.33	0.94
COL	1562	153.74^{c}	0.84	-	-	-	1478	175.60^{c}	0.88	1354	194.17^{c}	1.03			

£- Selected parents mean
Means with different superscripts within each column, trait and effect differ significantly (P<0.05)

Least square mean of body weight at six weeks of age of Japanese quail population subjected to the study was 196.85 ± 0.89 g. Prakash Babu *et al.* (1980), Arjun Kumar *et al*. (1990), Prabakaran (1992), Brah *et al*. (1997), El Deen (1999) and Vali *et al*. (2005) and many others found the same to be lower than that observed in the study. Caron *et al*. (1990) and Marks (1996) reported higher body weights at six weeks and values reported by Kocak *et al*. (1995), Nassiry and Antipov (1977), Ozcan *et al.* (2001), Dhaliwal *et al.* (2004), Feroz Mohammed (2004) and Shokoohmand *et al*. (2007) were almost comparable to the above values obtained in the study.

Overall, the least squares means of body weights at different ages recorded in the study were higher than most of the values available in the literature indicating that the Japanese quail population considered for the same was a genetically improved population for growth performance. Selected lines had significantly (P<0.05) higher body weights than the control line at all ages and the same steadily improved over subsequent generations indicating positive direct and correlated responses irrespective of the method or age at selection.

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