Effect of Non Genetic Factors on Absolute Growth Rate in Short Term Selection for Different Ages in Japanese quail (*Coturnix japonica*)

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Abstract

Meat type Japanese quail were subjected to three different methods of individual phenotypic selection *viz.*, high two week body weight (SWL), four week body weight (FWL) and high four week body weight coupled with low relative body weight gain between 4-6 weeks of age (LWL) and a control (COL) without adopting any selection for three generations. The effects of lines, generations, sexes and hatches were significant (P< 0.01) on absolute growth rate (AGW) of birds at all the ages were studied barring the influence of sex on body weight at hatch. The least square means of AGW during first, second, third, fourth, fifth and sixth week of age were 26.38±0.37, 43.66±0.64, 37.42±0.69, 27.70±0.70, 23.76±0.61 and18.02±0.56 g, respectively in base (S_0) generation and the corresponding means in first S_1 generation were 22.99±0.37, 32.93±0.65, 26.96±0.70, 27.82±0.71, 21.27±0.61 and 17.83±0.57 g. In second (S_2) generation the AGW were 28.44±0.36, 36.59±0.62, 49.08±0.66, 36.24±0.67, 17.91±0.58 and 18.57±0.54 g and the corresponding means in (S_3) generation were 27.42±033 37.97±0.57, 41.06±0.60, 34.16±0.61, 25.10±0.53 and 23.63±0.49g, respectively. The least squares means of AGW during first, second, third, fourth, fifth and sixth week of age were 26.00±0.33, 37.15±0.57, 38.46±0.62, 29.71±0.62, 17.46 ± 0.54 and 13.11±0.50 g in males and 26.61±0.0.32, 38.43± 0.56, 41.06± 0.60, 34.16±0.61, 25.10±0.53 and 23.63±0.49 g in females, respectively. The AGW of females was found to be significantly (P< 0.05) higher than that of males at all the ages studied.

Key Words: Japanese quail, selection, body weights, non genetic factors, absolute growth rate

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Introduction

In India, commercial quail farming has created a huge impact in recent years and many farms have been established throughout the country both for meat and egg production. Japanese quails are marketed at 4-5 weeks of age for meat with a body weight of 150-180 g. The females come into lay at about 6-7 weeks of age, reared for breeding upto 6-8 months of age and produce about 90-150 eggs with a weight of about 8-13 g. Tamilnadu, a state in south India is growing into a major producer and consumer of Japanese quail meat in India.

The growth rate of quail chicks is normally quite rapid from hatch to five weeks of age and slows down thereafter. Unlike all other domestic avian species, sexual dimorphism favours the female body weight in quail. Experimental research established that body weight of Japanese quail responded quickly to selection (Nestor *et al*., 1982; Caron *et al.,* 1990 and Marks, 1993). Selection for rapid growth at a specific age has resulted in a tremendous growth response. With this marked response there has been concomitant decrease in age at which body weight selection is applied. Thus, within a relatively short period of time, selection age and market weights have shifted to earlier ages and heavier weights respectively (Anthony, 1995).

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, 180 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.

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

The results of least squares analysis of variance of absolute growth rate (AGW) based on pooled data presented in Table- 1. The overall least squares means for AGW during 1, 2, 3, 4, 5 and 6 weeks of age were 26.31±0.31, 37.79± 0.54, 39.76±0.58, 31.93± 0.59, 21.28±0.52 and 18.37±0.48 g, respectively (Table-2).

Table: 1 Least squares analysis for variance of absolute weight gain

	Lines		Generations		Sexes		Hatches		Error
	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S
AGW1	3	2773.38**	3	6795.13**	1	519.87**	5	25745.89**	5549	49.72
AGW2	3	5899.62**	3	26820.34**	1	2297.48**	5	9290.66**	5549	149.17
AGW3	3	3294.73**	3	115484.44**	1	9362.21**	5	45551.47**	5549	173.19
AGW4	3	6472.73**	3	27437.96**	1	27455.05**	5	49921.60**	5549	177.66
AGW5	3	3329.69**	3	8542.22**	1	80789.21**	5	22244.90**	5549	134.53
AGW6	3	1625.29**	3	353.17*	1	153470.61**	5	2924.08**	5549	114.74

*Significant at P<0.05, **Significant at P<0.01

The least squares means of AGW ranged from 26.96±0.35g at first week to 37.42 ± 0.69 g third week and dropping steeply to 19.01±0.53 g at sixth week in SWL line. In FWL, AGW varied from 28.03 ±0.34 at 1^{st} week, 40.93 ±0.59 g at 2^{nd} week to 19.59 ±0.52 g at 6^{th} week. AGW in LWL was 25.10 ±0.36 at 1^{st} week 49.08 ±0.66 g at 3^{rd} week and 17.43 ±0.55 g at 6^{th}

week and the corresponding values for COL were 25.13±0.36, 45.57±0.61 and 17.44 ±0.55 g, respectively.

Line had a significant effect (P< 0.01) on absolute weight gain at all age intervals and the peak gain was witnessed during third week in the LWL and the COL lines while in FWL, it was during second and third week indicating that age and method of selection might influence the comparative weight gain levels during different age intervals which however, requires further validation. Generation also had a significant (P< 0.01) influence on absolute weight gain values and peak weight gains were registered during second week in S_0, S_1 and S_3 while in S_2 alone, peak gain was witnessed during third week.

Females had significantly (P< 0.01) higher values for absolute weight gain over males except during first week and the magnitude of difference was much wider during fifth and sixth week of age, probably as a consequence of growth of female reproductive organs as the birds approached sexual maturity. Metodiev and Drbohlav (1997) also made similar observations on the sexual dimorphism in body weight gain.

Feroz Mohammed (2004) too observed significant influence of strain, generation, sex and hatch on average daily gains while Punya Kumari (2007) vouched for the influence of generation on the same.

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

	AGW1			AGW2			AGW3			AGW4			AGW5			AGW6		
	N	**Mean**	**SE**	**N**	**Mean**	**SE**	**N**	**Mean**	**SE**	**N**	**Mean**	**SE**	**N**	**Mean**	**SE**	**N**	**Mean**	**SE**
Overall	**5562**	**26.31**	**0.31**	**5562**	**37.79**	**0.54**	**5562**	**39.76**	**0.58**	**5562**	**31.93**	**0.59**	**5562**	**21.28**	**0.52**	**5562**	**18.37**	**0.48**
Line																		
SWL	1469	26.96^{b}	0.35	1469	37.19^{b}	0.60	1427	37.42^{c}	0.69	1427	34.36^{a}	0.66	1427	22.36^{a}	0.57	1427	19.01^{a}	0.53
FWL	1307	28.03^{a}	0.34	1307	40.93^{a}	0.59	1263	26.96^{d}	0.70	1263	33.12^{a}	0.65	1263	22.86^{a}	0.56	1263	19.59^{a}	0.52
LWL	1443	25.10^{c}	0.36	1443	36.42^{b}	0.62	1541	49.08^{a}	0.66	1541	29.96^{b}	0.68	1541	20.30^{b}	0.59	1541	17.43^{b}	0.55
COL	1343	25.13^{c}	0.36	1343	36.62^{b}	0.63	1331	45.57^{b}	0.61	1331	30.30^{b}	0.69	1331	19.60^{b}	0.60	1331	17.44^{b}	0.55
Generation																		
S_0	1427	26.38^{c}	0.37	1427	43.66^{a}	0.64	1427	37.42^{b}	0.69	1427	27.70^{b}	0.70	1427	23.76^{a}	0.61	1427	18.02^{c}	0.56
S_1	1263	22.99^{d}	0.37	1263	32.93^{d}	0.65	1263	26.96^{c}	0.70	1263	27.82^{b}	0.71	1263	21.27^{b}	0.61	1263	17.83^{c}	0.57
S_2	1541	28.44^{a}	0.36	1541	36.59^{c}	0.62	1541	49.08^{a}	0.66	1541	36.24^{a}	0.67	1541	17.91^{c}	0.58	1541	18.57^{bc}	0.54
S_3	1331	27.42^{b}	0.33	1331	37.97^{b}	0.57	1343	37.60^{b}	0.68	1343	35.99^{a}	0.62	1343	22.17^{b}	0.54	1343	19.06^{a}	0.50
Sex																		
Male	2774	26.00^{a}	0.33	2774	37.15^{b}	0.57	2774	38.46^{b}	0.62	2774	29.71^{b}	0.62	2774	17.46^{b}	0.54	2774	13.11^{b}	0.50
Female	2788	26.61^{a}	0.32	2788	38.43^{a}	0.56	2788	41.06^{a}	0.60	2788	34.16^{a}	0.61	2788	25.10^{a}	0.53	2788	23.63^{a}	0.49
Hatch																		
1	1634	25.86^{c}	0.18	1634	35.88^{d}	0.30	1634	37.94^{b}	0.33	1634	45.79^{a}	0.33	1634	26.41^{b}	0.29	1634	20.04^{b}	0.27
2	1638	20.50^{e}	0.18	1638	42.27^{b}	0.30	1638	51.64^{a}	0.33	1638	29.59^{d}	0.33	1638	28.07^{a}	0.29	1638	18.75^{c}	0.27
3	1515	22.33^{d}	0.18	1515	38.54^{c}	0.32	1515	38.58^{b}	0.34	1515	33.92^{c}	0.35	1515	20.41^{c}	0.30	1515	16.17^{e}	0.28
4	708	36.73^{a}	0.28	708	34.91^{e}	0.49	708	36.30^{c}	0.53	708	38.10^{b}	0.54	708	14.55^{e}	0.47	708	17.34^{d}	0.43
5	42	17.49^{f}	1.11	42	29.22^{f}	1.92	42	51.31^{a}	2.07	42	15.01^{c}	2.09	42	18.35^{d}	1.82	42	13.44^{f}	1.68
6	25	34.9^{b}	1.43	25	45.92^{a}	2.48	25	22.79^{a}	2.67	25	29.20^{d}	2.71	25	19.88^{d}	2.36	25	24.48^{a}	2.17

Means with different superscripts within each column, trait and effect differ significantly (P<0.05)