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EFFECT OF NON GENETIC FACTORS ON RELATIVE BODY WEIGHT GAIN IN SHORT TERM SELECTION FOR DIFFERENT AGES IN JAPANESE QUAIL

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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 the relative body weight gain (RGW) of birds at all the ages studied. The least square means of RGW during first, second, third, fourth, fifth and sixth week of age in base S_0 generation were 370.37±3.85, 124.25 ± 2.20, 44.51±1.68, 24.15±0.0.69, 16.94±0.45 and 10.48±0.35 per cent. The corresponding means were 383.81±3.91, 115.03±2.23, 42.62±1.70, 31.90±0.70, 18.23±0.46 and 11.99±0.35 per cent in first S_1 generation, 374.04 ±3.76, 92.63 ±2.15, 75.08±1.64, 30.18±0.67, 12.25±0.44 and 12.22 ±0.34 per cent in second S_2 generation and 381.89±3.42, 103.61±1.96, 62.90±1.49, 30.68±0.61, 14.14±0.31 and 10.28±0.31 per cent in third S_3 generation. The least squares means of RGW during the above periods were 375.41±3.46, 107.62±1.98, 55.20±1.51, 27.93±0.62, 13.04±0.41and 8.70±0.31 per cent in males and 379.95±3.39, 110.14± 1.94, 57.35±1.48, 30.52±0.61, 17.24±0.40 and 13.77±0.31 per cent in females respectively. The RGW of females was found to be higher than that of males at all the ages studied and however the differences were significant after three weeks of age.

***Key Words**: Japanese quail- selection- body weights- relative body weight gain- non genetic factors*

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.

Absolute body weight gain makes, however, no allowance for differences in body frame (i.e. skeletal structure), nor does weight, by itself, accurately reflect a bird's condition. Although having the same body weight, a bird with a large frame will be in a poorer condition than a bird with a smaller frame. To correct for this bias, relative body weight gain may be used (Livestock system research manual, 1990).

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.

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

The results of least squares analysis of variance of RGW based on pooled data presented in Table: 1 revealed that the effects of lines, generations, sexes and hatches were significant (P< 0.01) on the RGW of chicks at all the ages studied. The overall least squares mean for RGW during 1, 2,3,4,5 and 6 weeks of age were 377.68±3.28, 108.88±1.87, 56.28±1.43, 29.23.10±0.59, 15.14±0.39 and 11.23± 0.30 g, respectively Table: 2.

Table: 1 Least squares analysis for variance of relative 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**
RGW1	3	39156.37**	3	82916.85**	1	23188.56*	5	3290113.57**	5549	4534.73
RGW2	3	14360.30**	3	192751.78**	1	6210.89*	5	527015.94**	5549	1531.73
RGW3	3	50029.97**	3	288762.14**	1	4949.23*	5	204658.66**	5549	783.63
RGW4	3	554.90**	3	6604.98**	1	4036.00**	5	22592.07**	5549	77.35
RGW5	3	160.63**	3	5051.37**	1	16533.14**	5	5790.24**	5549	45.96
RGW6	3	1157.45*	3	451.50**	1	31627.64**	5	864.06**	5549	36.04

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

The least squares means of RGW ranged from 374.39±3.69 at RGW1 to 11.58±0.33 per cent at RGW6 in SWL line, 383.21±3.58 to 11.10±0.32 per cent in FWL line, and 374.51±3.78 to 10.85±0.34 per cent LWL line respectively. In COL line the means RGW varied from 378.60 ±3.81 of RGW1 to 11.41±0.34 per cent of RGW6.

The least square means of RGW during first, second, third, fourth, fifth and sixth week of age in S_0 were 370.37±3.85, 124.25 ± 2.20, 44.51±1.68, 24.15±0.0.69, 16.94±0.45 and 10.48±0.35 per cent. The corresponding means were 383.81±3.91, 115.03±2.23, 42.62±1.70, 31.90±0.70, 18.23±0.46 and 11.99±0.35 per cent in S_1, 374.04 ±3.76, 92.63 ±2.15, 75.08±1.64, 30.18±0.67, 12.25±0.44 and 12.22 ±0.34 per cent in S_2 and 381.89±3.42, 103.61±1.96, 62.90±1.49, 30.68±0.61, 14.14±0.31 and 10.28±0.31 per cent in S_3.

The least squares means of RGW during the above periods were 375.41±3.46, 107.62±1.98, 55.20±1.51, 27.93±0.62, 13.04±0.41and 8.70±0.31 per cent in males and 379.95±3.39, 110.14± 1.94, 57.35±1.48, 30.52±0.61, 17.24±0.40 and 13.77±0.31 per cent in females respectively. The RGW of females was found to be higher than that of males at all the ages studied and however the differences were significant after three weeks of age. In all groups the RGW was the highest during 1^{st} week which then declined up to six weeks of age.

DISCUSSION

Line, generation, sex and hatch were found to significantly influence relative weight gain per cent also.

FWL birds had shown the largest rate of weight gain during 1st, 2^{nd} and 5^{th} week, LWL during 3^{rd} week, SWL during 4^{th} week and COL birds during 6^{th} week.

Relative weight gain was the highest during 1^{st} week in S_1, 2^{nd} week in S_0, 3^{rd} week in S_2 and 4^{th} week in S_1.

Sex had significant influence on the trait only from fourth week onwards with the females showing better rate of weight gain during later ages. Metodiev *et al*. (1997) and Punya Kumari (2007) also made similar observations.

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

	RGW1			RGW2			RGW3			RGW4			RGW5			RGW6		
	n	Mean	SE	n	Mean	SE	n	Mean	SE	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	**5444**	**377.68**	**3.28**	**5444**	**108.88**	**1.87**	**5444**	**56.28**	**1.43**	**5444**	**29.23**	**0.59**	**5444**	**15.14**	**0.39**	**5444**	**11.23**	**0.30**
Line																		
SWL	1351	374.39^{c}	3.69	1351	107.37^{b}	2.11	1351	53.76^{b}	1.61	1351	30.91^{a}	0.66	1351	15.35^{ab}	0.43	1351	11.58^{b}	0.33
FWL	1307	383.21^{a}	3.58	1307	112.73^{a}	2.04	1307	50.75^{c}	1.56	1307	28.43^{b}	0.64	1307	15.60^{a}	0.42	1307	11.10^{b}	0.32
LWL	1443	374.51^{b}	3.78	1443	105.71^{b}	2.16	1443	66.93^{a}	1.65	1443	28.42^{b}	0.68	1443	15.17^{a}	0.44	1443	10.85^{c}	0.34
COL	1343	378.60b	3.81	1343	109.71^{a}	2.18	1343	53.68^{b}	1.66	1343	29.15^{ab}	0.68	1343	14.45^{b}	0.45	1343	11.41^{a}	0.34
Generation																		
S_0	1427	370.37^{b}	3.85	1427	124.25^{a}	2.20	1427	44.51^{c}	1.68	1427	24.15^{c}	0.69	1427	16.94^{a}	0.45	1427	10.48^{b}	0.35
S_1	1263	383.81^{a}	3.91	1263	115.03^{b}	2.23	1263	42.62^{c}	1.70	1263	31.90^{a}	0.70	1263	18.23^{a}	0.46	1263	11.99^{a}	0.35
S_2	1423	374.64^{b}	3.76	1423	92.63^{d}	2.15	1423	75.08^{a}	1.64	1423	30.18^{b}	0.67	1423	12.25^{c}	0.44	1423	12.22^{a}	0.34
S_3	1331	381.89_{a}	3.42	1331	103.61^{c}	1.96	1331	62.90^{b}	1.49	1331	30.68^{ab}	0.61	1331	14.14^{b}	0.40	1331	10.28^{b}	0.31
Sex																		
Male	2717	375.41^{a}	3.46	2717	107.62^{a}	1.98	2717	55.20^{a}	1.51	2717	27.93^{b}	0.62	2717	13.04^{b}	0.41	2717	8.70^{b}	0.31
Female	2727	379.95^{a}	3.39	2727	110.14^{a}	1.94	2727	57.35^{a}	1.48	2727	30.52^{a}	0.61	2727	17.24^{a}	0.40	2727	13.77^{a}	0.31
Hatch																		
1	1634	291.45^{c}	1.84	1634	104.26^{c}	1.05	1634	55.98^{e}	0.80	1634	42.96^{a}	0.33	1634	18.13^{b}	0.22	1634	11.40^{b}	0.17
2	1520	242.24^{d}	1.92	1520	154.03^{a}	1.10	1520	82.85^{a}	0.84	1520	25.87^{d}	0.34	1520	18.99^{a}	0.23	1520	11.01^{c}	0.17
3	1515	292.47^{c}	1.91	1515	131.42^{b}	1.09	1515	58.78^{c}	0.83	1515	32.99^{b}	0.34	1515	15.08^{c}	0.22	1515	10.24^{d}	0.17
4	708	447.56^{b}	2.99	708	86.60^{d}	1.71	708	41.84^{d}	1.30	708	33.31^{b}	0.53	708	10.53^{a}	0.35	708	10.73^{d}	0.27
5	42	539.41^{a}	11.60	42	65.69^{e}	6.63	42	48.56^{b}	5.06	42	12.95^{e}	2.08	42	13.33^{de}	1.36	42	8.61^{e}	1.05
6	25	452.94^{b}	14.99	25	69.60^{e}	8.57	25	29.65^{a}	6.54	25	27.29^{c}	2.68	25	14.79^{c}	1.76	25	15.21^{a}	1.35

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

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