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PROGENY GROWTH PERFORMANCE AS INFLUENCED BY DIFFERENT PARENTAL BODY WEIGHTS IN FOUR CLOSE-BRED FLOCKS OF JAPANESE QUAILS *(COTURNIX COTURNIX JAPONICA)*

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ABSTRACT

The present study was conducted to investigate the effect of different parental body weights on 3-weeks progeny growth performance in four close-bred flocks of Japanese quails (*Coturnix coturnix japonica)*. A total of 432 adult (12 weeks-old) quails, comprising 108 males and 324 females were randomly divided into 108 experimental units in 1:3 male to female ratio. These experimental units were randomly assigned to 12 treatment groups having 4 close-bred flocks (imported, local-1, local-2 and local-3) × 3 female body weights (heavy 300-350g, medium 250-300g and small 200-250g) with Randomized Complete Block Design (RCBD) in factorial arrangements having 9 replicates in each treatment. The different parental body weight categories significantly ($p<0.05$) affected day-old, 1st, 2nd and 3rd weeks progeny body weight in Japanese quails. The heavy male parents had apparently more pronounced effect on day-old and 1st week progeny body weight. The cumulative progeny body weight gain in quails of different close-flocks differed significantly ($p<0.05$) in all the parental groups. The interaction between parental body size and close-bred flocks was significant ($p<0.05$). Effect of different parental body size on 1st , 2nd , and 3rd week cumulative progeny body weight gain, feed intake, FCR and mortality rates were also significant ($p<0.05$). The interaction between parental body size and close-bred flocks was significant for these parameters. In conclusion, progeny secured from heavy male parent had higher hatch weight, body weight, weight gain and feed intake than those hatched from medium and small male parents, showing more pronounced effect of male parent on progeny growth performance and on almost all the other parameters.

Key words: Japanese quail, body weight, weight gain, close-bred, feed intake, FCR, mortality percent.

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INTRODUCTION

Japanese quail considered as the best avian model and pilot bird in the field of research due to their faster growth rate, early sexual maturity, shorter generation interval, high rate of egg production, less feed consumption, easy and cheap maintenance, relatively easy to handle and resistance to many tropical diseases (Minvielle, 2004; Dhaliwal *et al.,* 2004; Narinc *et al.,* 2010; Daikwao *et al.,* 2013; Onyewuchi *et al.,* 2013; Saidu *et al.,* 2014). Since centuries; Japanese quail is considered as one of the most important source for meat and egg production in many European and Asian countries (Maiorano *et al.,* 2012; Ayasan, 2013; Tunsaringkarn *et al.,* 2013). Quail farming is also one of the most suitable and low capital investment, rapid return and easily adaptable enterprise all over the world including Pakistan. However, due to lack of knowledge, shortage of breeding stocks and good quality of day old chicks, Japanese quail is not emerging as a profitable enterprise. The quail meat is not as popular as chicken meat in the country. It is usually consumed as a special dish and at higher rates than chicken meat. The public and private sectors had taken measures for the development of quail farming as an industry, but such measures were not adequate and fall short of expectations for producing high yield of quail meat at a reasonable low cost. The technical reason for the slow development of the quail farming is the lack of application of modern quail production technology, particularly at small scale farmers (Akram *et al.,* 2008). Growth rate at different ages are useful selection criteria and important tool in most of the breeding programs in animal production; i.e. increase live body weight, weight gain, feed intake and mortality during early period of life (Hassan, 2011; Udeh and Omeje, 2011; Hussen *et al.,* 2016; Fadhil and Hassan, 2018).

Despite having enormous potential, very little research has been conducted on the acclimatization of Japanese quails to Pakistan's environment. Keeping above in view these issues, four different close-bred local and imported Japanese quail flocks have been maintained at Avian Research and Training Centre, Department of Poultry Production, University of Veterinary and Animal Sciences Lahore, Pakistan, with objectives of making attempts to improve productive and growth potentials of quails. The present study was planned to investigate the growth performance of progenies obtained from these close-bred flocks of Japanese quails of different parental body sizes up to the age of 3-weeks.

MATERIALS AND METHODS

The present study was conducted at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore, Pakistan. A total of 432 adult (12 weeks-old) quails, comprising 108 males and 324 females were used. The birds were randomly selected from the available stock and then divided into 108 experimental units (replicates comprising one male and three females of each.) These experimental units were randomly assigned to 12 treatment groups having 4 close-bred flocks by designating their name as Imported (Major), Local-1 (Kaleem) Local-2 (Saadat) and Local-3 (Zahid) × 3 female body weights with randomized complete block design in factorial arrangements having 9 replicates in each treatment. Further procedure was assumed after Jatoi *et al.* (2015a). On completion of hatching, day-old quail chicks from each replicate were weighed individually by using sophisticated digital balance. The chicks in each replicate were placed in French made brooding batteries under standard management conditions. The quail chicks were fed a balanced quail broiler starter ration *ad-libitum* (broiler starter crumbs feed grinded into mash form). The ration was formulated and prepared at Hi-Tech Feeds PVT (Ltd), Lahore, according to NRC standards (1994) (Table 1). The birds had a free access to clean and fresh drinking water through drinking nipple lines. The brooding temperature in battery cages for first week was maintained between 31ºC and 35ºC and then weekly reduced by 3ºC up to the age of 3 weeks (North and Bell, 1991). The experimental birds were tagged for their proper identification. Initial body weight at hatching and thereafter weekly body weight of quail chicks up to 3 weeks were recorded. The progeny growth parameters (day-old quail chicks weight (g), body weight (g), weight gain (g), feed intake (g/bird), FCR (feed/g gain) and mortality rate (%) were recorded up to the age of 3 weeks. Feed conversion ratio (FCR) was worked out for individual chicks on the basis of body weight gain and feed intake,

Statistical Analysis: The data collected were analyzed using ANOVA techniques with RCBD, with more than one observation for further interpretation using general linear model procedures (SAS 9.1, 2002-03), assuming the following mathematical model: (The mathematical model was assumed after Jatoi *et al.* (2015b)). The comparison of means was made using Duncan's Multiple Range (DMR) test (Duncan 1955).

Mathematical model:

$Yijkl = \mu + Fi + Sj + Wk + Sj \times Wk + eijkl$,

where:

Yijkl = the l*th* observation of the k*th* category of females of the j*th* category of males of the i*th* flock;

μ = population mean;

Fi = effect of the i*th* flock (i = 4), treated as blocks;

Sj = effect of the j*th* category of male (k = 3);

Wk = effect of the k*th* category of female (j = 3);

eijk = random error associated with the i*th* flock and j*th* body weight category.

RESULTS AND DISCUSSION

Body weight (g): In the present study, different parental body weight categories significantly (p<0.05) affected day-old progeny body weight and also 1st, 2nd and 3rd week body weight of Japanese quail. The heavy male parents had apparently more pronounced effect on day-old and 1s t week progeny body weights. The interaction between parental body size and close-bred flocks was significant (p<0.05) for 1st, 2nd and 3rd weeks progeny body weight except for day-old body weight (Table 2). The findings of this study indicating effect of parent body weight on progeny body weight could be due to higher day-old chick weight from heavy parents which subsequently lead to higher final body weight at 3rd week in the progeny. The similar findings indicating significant (p<0.05) effect of hatch weight on 2nd week body weight in quails have been reported (Saatci *et al.,* 2003; Saatci *et al.,* 2006; Shokoohmand *et al.,* 2007; Kumari *et al.,* 2009; Alkan *et al.,* 2010; Lotfi *et al.,* 2012). The earlier findings also indicated that maternal effect on chick weight was possibly mediated via egg composition of both the genetic and the environmental origin (Hartmann *et al.,* 2003; Dogan *et al.*, 2010; Hussen *et al.,* 2016). Furthermore; similar strain variation in average weekly body weight in broiler at 4-week of age has also been indicated by Yakubu *et al.* (2010). Hussain *et al.,* (2013) also reported significant improvement in body weight (g) in selected groups of Japanese quails at the age of 21 days. Dudusola (2013) reported that parental age was found to have a significant effect on the weight of day-old chick was found to be significant (P<0.05). It was also observed that with increasing egg weight, chick weight increased. Wang *et al.,* (2019) also reported that male chicken had better growth performance than female chickens. Furthermore Krishna and Sahitya Rani (2017) reported that body weight of the progeny obtained from baseline and selected female quail population was found to be higher than the parental population body weights at the end of the growth period. Significant effect of sex and line (*P* < 0.001) was also observed by Khaldari *et al.,*

(2010) in Japanese quail selected for 4-week body weight.

Weight gain (g): In the present study, effect of different parental body size on 1st, 2nd and 3rd week and cumulative progeny body weight gain was found to be significant (p<0.05). The interaction between parental body size and close-bred flocks was also significant (Table 3). The results of this study shows variation in body weight gain among different close-bred flocks are in agreement with the earlier findings of Yakubu *et al.,* (2010) who reported strain variation (p<0.05) in body weight gain in broilers at the age of 4-week. Furthermore; similar strain variation in body weight gain in Aseel chicken at different ages has also been indicated by Iqbal (2011). Hussain *et al.,* (2013) also reported significant improvement in body weight gain (g) in selected groups of Japanese quails at the age of 21 days. Similarly, Krishna and Sahitya Rani (2017) also reported that the body weight gain was found to be higher in the progeny than the parental population at six weeks of age.

Feed intake (g) and FCR: In the present study, 1st, 2nd and 3rd week and cumulative feed intake and feed conversion ratio of the progeny were significantly (p<0.05) influenced by parental body size of Japanese quails. The interaction between parental body size and close-bred flocks was significant (p<0.05) (Table 4 and 5). These results indicated variation in FCR in quail progenies from different close-bred flocks. Similar to present findings; Sahota *et al.,* (2003) reported significant (p<0.01) differences in feed conversion efficiency in progenies of Desi chickens in comparison to their parents. Similar findings of Yakubu *et al.,* (2010) who reported that strain variation (p<0.05) in average weekly feed intake in broilers at the age of 4-week. Hussain *et al.,* (2013) also reported significant improvement in feed intake (g) and FCR in selected groups of Japanese quails at the age of 21 days. The FCR in four varieties of Aseel was significantly (p<0.05) different at 1st, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th and 15th weeks of age (Iqbal 2011). The findings of the present study showing effect of parental body weight on progeny feed intake in quails are fully supported by those of Renden and McDaniel (1984) and Farooq (1989) who reported that daily feed intake was significantly (p<0.05) different between heavy and light hens and were directly related to their body weight. The maintenance requirement of feed has been reported to be increased with increase in body weight of birds which reduced availability of energy required for their growth (Rondelli *et al.,* 2003; Varkoohi *et al.,* 2010; Okenyi *et al.,* 2013). Krishna and Sahitya Rani (2017) also reported that feed conversion ratio of the progeny was found to be better feed conversion ratio compared with baseline and selected population during the growth period.

Mortality rate (%): In the present study, a significant (p<0.05) effect of different parental body weights on progeny mortality rate (%) during 1st, 2nd and 3rd week and cumulative progeny mortality rate was recorded. The mortality rate in quail progenies secured from small size parents was higher than those hatched from heavy and medium parents. The interaction between parental groups and close-bred flocks was significant (p<0.05) (Table 6). This high mortality rate could be attributed to small egg and chick size from small parents. These results agree with those of Among *et al.,* (1984) and Farooq (1989) who reported higher mortality rate in chicks hatched from smaller eggs than of larger eggs. Wilson (1991, 1991a) indicated that weight of the newly hatched chick was correlated with post-hatch growth and chick mortality. Yassin *et al.,* (2009) reported significant differences in first week mortality in broilers hatched from different broiler breeders. Livability in broilers may depend on day-old chick quality and farm management practices (Goodhope 1991; Wilson 1991a; El-Fiky *et al.,* 2000; Joseph and Moran 2005; Tona *et al.,* 2005; Decuypere and Bruggeman 2007; Umar *et al.,* 2013). Hussain *et al.,* (2013) also reported low mortality rate in selected groups of Japanese quails at the age of 21 days. Munisi *et al.,* (2015) reported that there were no differences in livability amongst genetic stocks.

Table-1. Feed composition.

Ingredients	%
Maize	50.0
Rice Polish	6.00
Canola Meal	1.98
Soybean Meal	30.54
Corn Gluten 60%	6.00
Lime stone	1.11
D-L Methionine	0.11
L- Lysine	0.22
Threonine	0.15
DCP	1.28
Vitamin Supplement	1.30
Rock Salt	0.30
Composition of nutrients	
NUTRIENTS	**VALUES**
ME Kcal/kg	2900
CP %	24.00
Ca %	0.80
Available P %	0.30
Phytate P %	0.34
Total P %	0.65
Crude Fiber %	4.38
Linoleic acid %	1.42
Methionine %	0.50
Lysine %	1.30

Table-2. Day-old, 1st, 2nd and 3rd week progeny body weight (g) influenced by 3 parental body weight categories from 4 close-bred flocks of Japanese quails.

♂ / ♀	Heavy			Medium			Small		
	Heavy	Medium	Small	Heavy	Medium	Small	Heavy	Medium	Small
(Mean ± SE*; DO**g)									
Imported	8.00 ±0.11^{abA}	7.71 ±0.18^{abcdA}	7.91 ±0.15^{abcA}	7.60 ±0.14^{abcdA}	7.33 ±0.12^{abcdA}	7.49 ±0.16^{abcdA}	7.55 ±0.18^{abcdA}	7.46 ±0.10^{abcdA}	7.30 ±0.25^{bcdA}
Local-1	7.66 ±0.34^{abcdA}	7.43 ±0.23^{abcdA}	7.64 ±0.27^{abcdA}	7.74 ±0.12^{abcdA}	7.35 ±0.49^{abcdA}	7.58 ±0.04^{abcdA}	7.51 ±0.16^{abcdA}	7.50 ±0.17^{abcdA}	7.61 ±0.10^{abcdA}
Local-2	7.98 ±0.19^{abcA}	7.41 ±0.64^{abcdA}	7.68 ±0.25^{abcdA}	7.85 ±0.06^{abcA}	7.50 ±0.18^{abcdA}	7.64 ±0.16^{abcdA}	7.40 ±0.10^{abcdA}	7.19 ±0.07^{bcdA}	7.25 ±0.34^{bcdA}
Local-3	7.70 ±0.21^{abcdA}	7.15 ±0.44^{cdA}	8.14 ±0.23^{aA}	7.83 ±0.26^{abcA}	7.74 ±0.23^{abcdA}	7.28 ±0.13^{bcdA}	7.69 ±0.03^{abcdA}	6.98 ±0.20^{dA}	7.24 ±0.09^{bcdA}
(Mean ± SE*; 1st wk†g)									
Imported	27.77 ±0.99^{abcdA}	27.96 ±1.19^{abcA}	27.64 ±0.52^{abcdeA}	25.92 ±1.58^{abcdeA}	28.49 ±1.66^{aA}	25.38 ±0.85^{abcdeA}	27.78 ±1.26^{abcdA}	28.04 ±2.98^{abA}	26.72 ±0.62^{abcdeA}
Local-1	26.23 ±1.55^{abcdeA}	24.89 ±1.12^{abcdeA}	26.55 ±0.50^{abcdeA}	26.37 ±0.23^{abcdeA}	26.27 ±1.17^{abcdeA}	26.90 ±0.35^{abcdeA}	25.50 ±0.58^{abcdeA}	26.57 ±0.65^{abcdeA}	25.09 ±0.21^{abcdeA}
Local-2	27.54 ±0.53^{abcdeA}	23.85 ±1.80^{eB}	23.96 ±1.50^{deB}	27.01 ±0.58^{abcdeA}	25.69 ±0.15^{abcdeA}	26.26 ±0.19^{abcdeA}	24.10 ±0.37^{deB}	23.81 ±0.45^{eB}	24.02 ±1.35^{deA}
Local-3	25.69 ±1.18^{abcdeA}	24.18 ±2.15^{cdeAB}	27.41 ±0.33$^{abcde\ A}$	25.98 ±0.63^{abcdeA}	25.25 ±0.59^{abcdeA}	24.83 ±1.18^{abcdeA}	24.55 ±0.60^{bcdeAB}	24.02 ±0.29^{deAB}	24.35 ±0.21^{bcdeA}
(Mean ± SE*; 2nd wk†g)									
Imported	58.80 ±1.23^{abcdeA}	62.10 ±1.73^{abcdeA}	60.04 ±1.63^{abcdeA}	60.01 ±4.06^{abcdeA}	58.92 ±0.68^{abcdeA}	55.88 ±3.09^{bcdeA}	60.69 ±3.55^{abcdeA}	59.21 ±3.59^{abcdeA}	54.02 ±3.06^{cdeA}
Local-1	55.58 ±1.64^{bcdeA}	57.28 ±2.13^{abcdeA}	61.09 ±a1.52^{bcdA}	60.79 ±2.29^{abcdeA}	55.09 ±3.18^{bcdeA}	65.51 ±0.89^{aA}	57.59 ±0.82^{abcdeA}	59.26 ±1.81^{abcdeA}	54.56 ±0.93^{bcdeB}
Local-2	62.71 ±1.20^{abcA}	52.92 ±5.49^{deB}	56.05 ±2.62^{bcdeA}	61.39 ±1.38^{abcA}	58.38 ±2.20^{abcdeA}	58.97 ±1.55^{abcdeA}	55.79 ±0.76^{bcdeA}	52.62 ±0.77^{eB}	54.05 ±2.99^{cdeB}
Local-3	60.20 ±a2.36^{bcdeA}	55.80 ±4.56^{bcdeAB}	60.40 ±1.02^{abcdeA}	57.91 ±1.06^{abcdeA}	53.85 ±2.85^{cdeB}	54.57 ±1.92^{bcdeB}	61.21 ±1.70^{abcdA}	54.59 ±0.74^{bcdeAB}	56.86 ±0.85^{bcdeB}
(Mean ± SE*; 3rd wk†g)									
Imported	105.53 ±2.83^{abcdA}	102.13 ±2.07^{bcdefA}	104.53 ±3.07^{abcdA}	111.91 ±4.26^{abA}	104.69 ±5.11^{abcdA}	99.18 ±3.66^{cdefA}	113.52 ±3.96^{aA}	103.61 ±3.60^{abcdefA}	95.15 ±4.26^{defA}
Local-1	99.58 ±1.23^{cdefB}	103.61 ±1.35^{abcdefA}	101.79 ±2.48^{bcdefA}	103.85 ±2.49^{abcdefB}	97.09 ±4.60^{cdefB}	106.68 ±4.24^{abcB}	101.72 ±2.20^{bcdefB}	102.42 ±1.62^{abcdefA}	94.48 ±3.59^{defA}
Local-2	105.51 ±3.65^{abcdA}	96.65 ±5.44^{cdefA}	97.02 ±3.78^{cdefB}	106.99 ±4.79^{abcAB}	101.18 ±2.17^{bcdefAB}	101.90 ±2.61^{bcdefAB}	100.46 ±0.44^{cdefB}	93.05 ±3.57^{efB}	92.68 ±3.76f^{B}
Local-3	104.53 ±2.45^{abcdA}	98.40 ±4.78^{cdefA}	103.13 ±0.50^{bcdefAB}	104.47 ±3.36^{abcdeA}	94.88d ±1.74^{efB}	96.34 ±2.53^{cdefAB}	107.13 ±2.90^{abcAB}	97.03 ±1.43^{cdefAB}	98.22 ±1.88^{cdefAB}

Different small alphabets on means in a row show significant differences at p<0.05
Different capital alphabets on means in a column show significant differences at p<0.05
*SE = Standard error
**DO = Day-old
*wk = Week

Table-3. 1st, 2nd, 3rd and 3-week progeny weight gain (g) influenced by 3 parental body weight categories from 4 close-bred flocks of Japanese quails.

♂ / ♀	Heavy			Medium			Small		
	Heavy	**Medium**	**Small**	**Heavy**	**Medium**	**Small**	**Heavy**	**Medium**	**Small**
				(Mean ± SE*; 1st wk**g)					
Imported	19.76 ±0.90^{abcdA}	20.24 ±1.03^{abcA}	19.73 ±0.40^{abcdA}	18.32 ±1.44^{abcdA}	21.16 ±1.58^{aA}	17.89 ±0.74^{abcdA}	20.22 ±1.14^{abcA}	20.57 ±2.99^{abA}	19.41 ±0.81^{abcdA}
Local-1	18.57 ±1.36^{abcdA}	17.36 ±0.89^{bcdB}	18.91 ±0.77^{abcdA}	18.63 ±0.22^{abcdA}	18.92 ±0.74^{abcdA}	19.32 ±0.40^{abcdA}	17.99 ±0.48^{abcdA}	19.07 ±0.40^{abcdA}	17.47 ±0.29^{bcdA}
Local-2	19.55 ±0.69^{abcdA}	16.44 ±1.45^{dB}	16.28 ±1.75^{dB}	19.16 ±0.51^{abcdA}	18.19 ±0.05^{abcdA}	18.62 ±0.24^{abcdA}	16.69 ±0.33^{cdB}	16.61 ±0.39^{dB}	16.77 ±1.05^{cdAB}
Local-3	17.99 ±1.27^{abcdA}	17.03 ±1.73^{bcdAB}	19.27 ±0.25^{abcdAB}	18.14 ±0.49^{abcdA}	17.51 ±0.58^{bcdA}	17.54 ±1.07^{bcdA}	16.86 ±0.58^{cdAB}	17.03 ±0.10^{bcdB}	17.10 ±0.12^{bcdAB}
				(Mean ± SE*; 2nd wk**g)					
Imported	38.60 ±1.20^{bcdA}	34.13 ±0.58^{abcA}	32.40 ±1.15^{abcdA}	34.09 ±3.12^{abcA}	30.43 ±2.31^{bcdA}	30.50 ±2.44^{bcdA}	32.90 ±3.31^{abcdA}	31.16 ±0.88^{bcdA}	27.30 ±3.60^{dA}
Local-1	29.35 ±0.87^{cdA}	32.48 ±1.47^{abcdA}	34.53 ±1.96^{abcA}	34.41 ±2.06^{abcA}	28.82 ±2.46^{cdA}	38.60 ±1.20^{Ab}	32.08 ±0.28^{bcdA}	32.68 ±1.84^{abcdA}	29.47 ±0.89^{cdA}
Local-2	35.17 ±1.11^{abcB}	29.07 ±3.71^{cdB}	32.09 ±1.99^{bcdA}	34.37 ±0.80^{abcA}	32.69 ±2.32^{abcdA}	32.70 ±1.37^{abcdAB}	31.69 ±0.40^{bcdA}	28.80 ±0.97^{cdB}	30.02 ±1.66^{cdAB}
Local-3	34.50 ±1.22^{abcAB}	31.61 ±2.41^{bcdA}	32.98 ±1.09^{abcdA}	31.92 ±1.69^{bcdB}	28.59 ±2.25^{cdB}	29.74 ±2.46^{cdAB}	36.66 ±1.47^{abAB}	30.57 ±0.73^{bcdAB}	32.50 ±0.64^{abcdAB}
				(Mean ± SE*; 3rd wk**g)					
Imported	46.73 ±1.82^{abcA}	40.03 ±3.11^{cdA}	44.49 ±2.94^{bcdA}	51.90 ±4.45^{abA}	45.76 ±5.28^{abcdA}	43.30 ±0.85^{cdA}	52.83 ±2.42^{aA}	44.40 ±1.30^{bcdA}	41.13 ±1.62^{cdA}
Local-1	44.00 ±0.57^{cdA}	46.33 ±0.83^{abcdB}	40.70 ±0.97^{cdA}	43.06 ±1.43^{cdB}	42.00 ±1.52^{cdB}	41.16 ±3.34^{cdA}	44.13 ±2.29^{cdB}	43.16 ±0.52^{cdA}	39.92 ±2.70^{cdA}
Local-2	42.80 ±2.50^{cdA}	43.73 ±0.13^{cdAB}	40.96 ±1.22^{cdA}	45.60 ±4.32^{abcdAB}	42.80 ±1.67^{cdAB}	42.93 ±2.05^{cdA}	44.66 ±0.65^{bcdAB}	40.43 ±2.91^{cdA}	38.63 ±1.27^{dB}
Local-3	44.33 ±0.92^{bcdA}	42.60 ±1.51^{cdAB}	42.73 ±1.49^{cdA}	46.56 ±4.08^{abcdAB}	41.03 ±1.18^{cdAB}	41.76 ±1.49^{cdA}	45.91 ±1.58^{abcdAB}	42.43 ±0.72^{cdA}	41.36 ±1.02^{cdAB}
				(Mean ± SE*; 3-wk** cum†g)					
Imported	109.54 ±1.09^{Aa}	100.58 ±1.68^{abcdA}	94.85 ±4.48^{cdefgA}	103.00 ±7.14^{abcA}	92.02 ±6.46^{cdefghijA}	88.18 ±3.81^{defghijA}	97.95 ±1.81^{bcdeA}	98.14 ±3.31^{bcdeA}	89.12 ±4.85^{defghijA}
Local-1	96.99 ±5.44^{bcdefB}	91.49 ±8.13^{cdefghijB}	95.07 ±1.82^{bcdefgA}	92.80 ±3.71^{bcdefghiB}	97.34 ±1.04^{bcdeB}	93.10 ±1.09^{bcdefghiB}	94.17 ±4.50^{bcdefghB}	89.66 ±2.92^{defghijAB}	89.38 ±3.19^{defghijA}
Local-2	92.60 ±2.05^{bcdefghiBC}	96.73 ±0.78^{bcdefAB}	93.92 ±2.94^{bcdefghB}	82.88 ±1.78^{ghijkBC}	104.76 ±2.61^{abBC}	85.74 ±4.59^{efghijkABC}	79.76 ±0.72^{jkC}	96.83 ±2.87^{bcdefAB}	94.44 ±2.10^{bcdefghB}
Local-3	87.12 ±2.60^{efghijkD}	84.46 ±1.51^{fghijkBC}	83.42 ±2.32^{ghijkBC}	81.03 ±4.51^{ijkBC}	81.94 ±4.13^{hijkAD}	76.20 ±3.40^{kC}	90.82 ±3.54^{cdefghijABC}	86.61 ±3.98^{efghijkABC}	83.60 ±0.84^{ghijkABC}

Different small alphabets on means in a row show significant differences at $p<0.05$
Different capital alphabets on means in a column show significant differences at $p<0.05$
*SE = Standard error
**wk = Week
†cum = Cumulative

Table-4. 1st, 2nd, 3rd week and cumulative progeny feed intake (g) influenced by 3 parental body weight categories from 4 close-bred flocks of Japanese quails.

♂ / ♀	Heavy			Medium			Small		
	Heavy	**Medium**	**Small**	**Heavy**	**Medium**	**Small**	**Heavy**	**Medium**	**Small**
				(Mean ± SE*; 1st wk**g)					
Imported	55.06 ±4.87^{abA}	50.40 ±2.91^{abcA}	50.63 ±2.75^{abcA}	47.83 ±6.49^{abcdA}	38.50 ±2.02^{bcdA}	48.30 ±7.37^{abcA}	50.16 ±7.09^{abcA}	42.93 ±7.51^{abcdA}	45.73 ±7.06^{abcdA}
Local-1	51.33 ±8.41^{abcA}	42.00 ±4.04^{abcdA}	44.80 ±8.60^{abcdB}	46.66 ±8.41^{abcdA}	38.50 ±2.02^{bcdA}	47.83 ±5.08^{abcdB}	39.66 ±2.33^{abcdA}	32.43 ±2.86^{dB}	50.16 ±5.83^{abcB}
Local-2	41.06 ±4.14^{abcdA}	56.46 ±5.67^{Aa}	36.40 ±1.40^{cdAB}	34.30 ±4.60^{cdB}	42.23 ±3.38^{abcdA}	41.52 ±1.99^{abcdAB}	35.00 ±4.04^{cdA}	37.10 ±3.59^{cdAB}	45.26 ±6.06^{abcdAB}
Local-3	42.00 ±4.04^{abcdA}	37.10 ±3.05^{cdAB}	39.90 ±6.72^{abcdAB}	35.93 ±2.91^{cdAB}	35.93 ±0.93^{cdB}	38.96 ±3.03^{bcdAB}	41.06 ±0.93^{abcdAB}	37.80 ±5.61^{bcdAB}	34.76 ±2.22^{cdAB}
				(Mean ± SE*; 2nd wk**g)					
Imported	110.83 ±10.36^{bcA}	109.66 ±6.17^{bcdA}	102.66 ±6.17^{bcdefA}	149.33 ±4.66^{aA}	109.66 ±10.17^{bcdA}	100.33 ±9.33^{bcdefgA}	114.33 ±10.17^{bcA}	95.66 ±4.66^{cdefghA}	86.33 ±4.66^{defghijA}
Local-1	107.33 ±4.66^{bcdeA}	105.00 ±4.04^{bcdeA}	86.33 ±9.33^{defghijA}	93.33 ±2.33^{cdefghiB}	107.33 ±6.17^{bcdeA}	91.00 ±4.04^{cdefghijA}	107.33 ±10.17^{bcdeA}	74.66 ±6.17^{hijB}	91.00 ±7.00^{cdefghijA}
Local-2	84.00 ±4.04^{efghijB}	91.00 ±4.04^{cdefghijB}	107.33 ±6.17^{bcdeB}	84.00 ±7.00^{efghijAB}	121.33 ±6.17^{bB}	93.33 ±10.17^{cdefghiA}	67.66 ±6.17^{jB}	98.00 ±4.04^{bcdefghAB}	112.00 ±4.04^{bcB}
Local-3	91.00 ±8.08^{cdefghijAB}	77.00 ±4.04^{ghijAB}	79.33 ±4.66^{fghijAB}	77.00 ±8.08^{ghijAB}	79.33 ±10.17^{fghijB}	70.00 ±7.00^{ijB}	84.00 ±4.04^{efghijAB}	77.00 ±8.08^{ghijAB}	86.33 ±8.41^{defghijA}
				(Mean ± SE*; 3rd wk**g)					
Imported	171.67 ±10.10^{abcA}	151.67 ±6.17^{bcdefgA}	140.00 ±10.69^{cdefghijkA}	196.00 ±20.20^{aA}	156.33 ±16.33^{abcdeA}	144.67 ±11.66^{bcdefghiA}	158.67 ±8.41^{abcdeA}	154.00 ±10.69^{bcdeA}	119.00 ±4.04^{hijklA}
Local-1	142.33 ±6.17^{cdefghijkB}	144.67 ±10.17^{bcdefghiB}	135.33 ±8.41^{defghijkA}	149.33 ±2.33^{bcdefgB}	130.67 ±6.17^{efghijklB}	137.67 ±4.66^{defghijkA}	151.67 ±6.17^{bcdefgB}	109.67 ±8.41^{klB}	133.00 ±10.69^{efghijklB}
Local-2	144.67 ±12.34^{bcdefghiAB}	142.33 ±2.33^{cdefghijB}	165.67 ±4.66^{bcdB}	123.67 ±10.17^{fghijklC}	175.00 ±4.04^{abA}	149.33 ±12.99^{bcdefghA}	81.67 ±2.33^{mC}	151.67 ±9.33^{bcdefgA}	154.00 ±4.04^{bcdefB}
Local-3	133.00 ±10.69^{efghijklAB}	121.33 ±6.17^{ghijklAB}	121.33 ±8.41^{ghijklAB}	105.00 ±7.001^{mCD}	128.33 ±10.17^{efghijklAB}	112.00 ± 8.08^{jklB}	144.67 ±9.33^{bcdefghiAB}	140.00 ±10.69^{cdefghijkAB}	116.67 ±6.17^{ijklAB}
				(Mean ± SE*; 3-wk** cum†, g)					
Imported	337.40 ±25.21^{bA}	311.73 ±8.71^{bcdA}	293.30 ±18.31^{bcdefgA}	393.17 ±30.66$^{a A}$	304.50 ±27.33^{bcdeA}	293.30 ±28.35^{bcdefghA}	323.17 ±25.58^{bcA}	292.60 ±21.20^{bcdefghA}	251.07 ±15.47^{efghijA}
Local-1	301.00 ±18.52^{bcdefB}	291.67 ±16.82^{bcdefgB}	266.47 ±24.93^{cdefghiB}	289.33 ±8.41^{bcdefghB}	276.50 ±10.10^{bcdefghiB}	276.50 ±11.25^{bcdefghA}	298.67 ±18.22^{bcdefghB}	216.77 ±17.05^{ijB}	274.17 ±20.6^{cdefghiAB}
Local-2	269.73 ±16.19^{cdefghiBC}	289.80 ±0.80^{bcdefghABC}	309.40 ±9.83^{bcdAB}	241.97 ±15.99^{efghijBC}	338.57 ±12.71^{bAB}	284.20 ±21.76^{bcdefghA}	184.33 ±11.66^{jC}	286.77 ±9.41^{bcdefghA}	311.27 ±6.06^{bcdABC}
Local-3	266.00 ±21.38^{cdefghiBC}	235.43 ±9.73^{hijCD}	240.57 ±17.38^{fghijABC}	218.40 ±17.10^{ijBC}	243.60 ±20.25^{efghijBC}	220.97 ±15.58^{ijB}	269.73 ±13.91^{cdefghiABC}	254.80 ±23.26^{defghijAB}	237.77 ±14.06^{ghijAB}

Different small alphabets on means in a row show significant differences at p<0.05
Different capital alphabets on means in a column show significant differences at p<0.05
*SE = Standard error
Wk** = week
Cum† = Cumulative

Table-5. 1st, 2nd, 3rd week and cumulative progeny feed conversion ratio (FCR*) influenced by 3 parental body weight categories from 4 close-bred flocks of Japanese quails.

♂ / ♀	Heavy			Medium			Small		
	Heavy	**Medium**	**Small**	**Heavy**	**Medium**	**Small**	**Heavy**	**Medium**	**Small**
				(Mean ± SE, 1st wk***)**					
Imported	2.77 ±0.12^{abA}	2.48 ±0.02^{abA}	2.57 ±0.18^{abA}	2.68 ±0.51^{abA}	1.83 ±0.15^{bA}	2.74 ±0.54^{abA}	2.50 ±0.39^{abA}	2.26 ±0.60^{bA}	2.39 ±0.49^{bA}
Local-1	2.85 ±0.64^{abA}	2.42 ±0.21^{abA}	2.39 ±0.50^{bB}	2.49 ±0.43^{abA}	2.04 ±0.18^{bA}	2.48 ±0.30^{abA}	2.20 ±0.07^{bA}	1.69 ±0.10^{bA}	2.86 ±0.29^{abA}
Local-2	2.11 ±0.27^{bA}	3.54 ±0.63^{aB}	2.31 ±0.36^{bB}	1.77 ±0.20^{bB}	2.32 ±0.18^{bA}	2.22 ±0.07^{bA}	2.10 ±0.28^{bA}	2.24 ±0.26^{bA}	2.74 ±0.47^{abA}
Local-3	2.34 ±0.19^{bA}	2.21 ±0.27^{bAB}	2.06 ±0.31^{bB}	2.00 ±0.11^{bAB}	2.05 ±0.09^{bA}	2.22 ±0.12^{bA}	2.44 ±0.13^{abA}	2.22 ±0.34^{bA}	2.03 ±0.11^{bA}
				(Mean ± SE, 2nd wk***)**					
Imported	3.56 ±0.31^{abcdA}	3.21 ±0.15^{bcdefgA}	3.18 ±0.27^{bcdefgA}	4.46 ±0.50^{bA}	3.69 ±0.60^{abcA}	3.38 ±0.59^{bcdeA}	3.62 ±0.72^{abcdA}	3.07 ±0.12^{bcdefghA}	3.24 ±0.29^{bcdefgA}
Local-1	3.65 ±0.14^{abcdA}	3.25 ±0.26^{bcdefgA}	2.49 ±0.19^{efghB}	2.73 ±0.18^{bcdefghB}	3.76 ±0.31^{abA}	2.36 ±0.16^{efghB}	3.34 ±0.32^{bcdefgB}	2.28 ±0.17^{bcdefghA}	3.08 ±0.14^{bcdefghA}
Local-2	2.39 ±0.18^{efghB}	3.19 ±0.25^{bcdefgA}	3.34 ±0.08^{bcdefAB}	2.45 ±0.23^{efghAB}	3.72 ±0.07^{abA}	2.89 ±0.43^{bcdefghB}	2.13 ±0.20^{hC}	3.41 ±0.22^{bcdeA}	3.76 ±0.32^{abB}
Local-3	2.62 ±d0.14^{efghB}	2.44 ±0.07^{efghB}	2.41 ±0.16^{efghAB}	2.41 ±0.27^{efghAB}	2.76 ±0.21^{bcdefghB}	2.40 ±0.36^{efghAB}	2.30 ±0.16^{ghAC}	2.51 ±0.22^{efghA}	2.65 ±0.27^{cdefghAB}
				(Mean ± SE, 3rd wk***)**					
Imported	3.66 ±0.09^{abcdefA}	3.85 ±0.45^{abcdA}	3.16 ±0.25^{defghA}	3.77 ±0.16^{abcdeA}	3.45 ±0.31^{abcdefgA}	3.35 ±0.32^{abcdefgA}	3.01 ±0.17^{efghiA}	3.46 ±0.14^{abcdefgA}	2.89 ±0.03^{fghiA}
Local-1	3.23 ±0.11^{cdefghA}	3.12 ±0.22^{defghB}	3.31 ±0.12^{bcdefghAB}	3.47 ±0.17^{abcdefgAB}	3.10 ±0.03^{defghAB}	3.41 ±0.42^{abcdefgA}	3.46 ±0.31^{abcdefgAB}	2.53 ±0.17^{hiB}	3.34 ±0.25^{abcdefB}
Local-2	3.40 ±0.31^{abcdefgA}	3.25 ±0.05^{bcdefghAB}	4.04 ±0.01^{abABC}	2.78 ±0.42^{ghiBC}	4.09 ±0.12^{aA}	3.48 ±0.30^{abcdefgA}	1.82 ±0.06^{jC}	3.75 ±0.09^{abcdeA}	3.99 ±0.17^{abcB}
Local-3	3.00 ±0.23^{efghiA}	2.85 ±0.18^{ghiABC}	2.84 ±0.21^{ghiABCD}	2.26 ±0.09^{iBC}	3.14 ±0.32^{defghAB}	2.70 ±0.28^{ghiAB}	3.14 ±0.14^{defghAB}	3.29 ±0.20^{bcdefghAB}	2.82 ±0.13^{ghiAB}
				(Mean ± SE, 3-wk*** cum†)**					
Imported	3.07 ±0.20^{bcdA}	3.10 ±0.10^{bcdA}	3.08 ±0.06^{bcdA}	3.81 ±0.05^{aA}	3.31 ±0.20^{bA}	3.32 ±0.1^{bA}	3.30 ±0.26^{bcA}	2.97 ±0.12^{bcdA}	2.81 ±0.02^{bcdeA}
Local-1	3.10 ±0.11^{bcdA}	3.20 ±0.12^{bcA}	2.80 ±0.28^{bcdeB}	3.13 ±0.21^{bcdB}	2.83 ±0.08^{bcdeB}	2.97 ±0.12^{bcdB}	3.16 ±0.05^{bcdB}	2.41 ±0.11^{efB}	3.06 ±0.17^{bcdB}
Local-2	2.90 ±0.11^{bcdA}	2.99 ±0.02^{bcdA}	3.29 ±0.02^{bcAB}	2.91 ±0.17^{bcdB}	3.23 ±0.04^{bcAB}	3.32 ±0.21^{bA}	2.30 ±0.13^{fC}	2.96 ±0.01^{bcdA}	3.30 ±0.13^{bcAB}
Local-3	3.04 ±0.15^{bcdA}	2.78 ±0.07^{cdeAB}	2.87 ±0.12^{bcdeB}	2.69 ±0.10^{defBC}	2.96 ±0.13^{bcdAB}	2.90 ±0.18^{bcdB}	2.96 ±0.13^{bcdAB}	2.93 ±0.21^{bcdA}	2.84 ±0.18^{bcdeAB}

Different small alphabets on means in a row show significant differences at $p<0.05$
Different capital alphabets on means in a column show significant differences at $p<0.05$
*FCR = Feed conversion ratio
**SE = Standard error
wk*** = WK= Week
cum† = Cumulative

Table-6. 1st, 2nd, 3rd week and cumulative progeny mortality rate (%) influenced by 3 parental body weight categories from 4 close-bred flocks of Japanese quails.

♂ / ♀	Heavy			Medium			Small		
	Heavy	**Medium**	**Small**	**Heavy**	**Medium**	**Small**	**Heavy**	**Medium**	**Small**
				(Mean ± SE*; 1st wk**, %)					
Imported	27.47 ±5.88^{abcdefghA}	19.82 ±3.10^{cdefghiA}	26.05 ±2.33^{abcdefghA}	21.18 ±2.76^{abcdefghiA}	12.42 ±1.05^{hiA}	28.40 ±1.14^{abcdefgA}	13.76 ±2.14^{ghiA}	24.91 ±6.71^{abcdefghA}	21.55 ±2.92^{abcdefghiA}
Local-1	16.76 ±3.69^{efghiA}	18.28 ±3.73^{defghiA}	31.73 ±6.08^{abcdeA}	22.77 ±4.23^{abcdefghA}	19.38 ±2.13^{defghiA}	36.40 ±2.65^{aA}	24.82 ±3.89^{abcdefghAB}	19.85 ±5.14^{cdefghiA}	31.53 ±5.83^{abcdefA}
Local-2	35.14 ±9.51^{abcdB}	33.35 ±3.69^{abcdA}	13.90 ±1.83^{ghiB}	6.96 ±2.43^{iB}	21.71 ±2.67^{abcdefghiA}	21.58 ±2.09^{abcdefghiA}	12.03 ±3.12^{iA}	23.10 ±0.89^{abcdefghA}	16.10 ±7.64^{fghiA}
Local-3	31.02 ±10.13^{abcdefA}	23.29 ±4.12^{abcdefghA}	29.91 ±4.70^{abcdeAC}	20.53 ±2.72^{bcdefghiA}	25.69 ±4.22^{abcdefghA}	16.10 ±7.64^{aA}	27.16 ±2.09^{abcdefghAB}	35.69 ±6.21^{abA}	23.83 ±3.44^{abcdefghA}
				(Mean ± SE*; 2nd wk**, %)					
Imported	8.34 ±0.65^{abcdeA}	6.74 ±3.31^{abcdeA}	6.62 ±2.05^{abcdeA}	6.87 ±0.29^{abcdeA}	6.27 ±1.71^{abcdeA}	3.74 ±3.54^{bcdeA}	5.36 ±1.09^{abcdeA}	3.97 ±3.33^{bcdeA}	12.57 ±2.88^{aA}
Local-1	5.70 ±3.18^{abcdeA}	4.29 ±1.34^{bcdeA}	1.78 ±1.38^{cdeB}	10.67 ±2.54^{abB}	0.44 ±0.01^{eB}	2.98 ±2.76^{bcdeA}	0.83 ±0.61^{deB}	8.47 ±1.93^{abcdeA}	1.11 ±0.37^{deB}
Local-2	10.39 ±1.52^{abB}	1.68 ±0.88^{cdeB}	3.00 ±1.10^{bcdeA}	5.87 ±2.48^{abcdeA}	4.84 ±2.51^{abcdeA}	1.53 ±0.42^{cdeB}	3.00 ±0.27^{bcdeA}	2.95 ±1.06^{bcdeB}	1.45 ±0.80^{deB}
Local-3	9.63 ±2.07^{abcAB}	3.71 ±3.60^{bcdeAB}	1.32 ±1.15^{deAB}	7.07 ±3.36^{abcdeA}	3.17 ±1.36^{bcdeAB}	8.82 ±6.49^{abcdAB}	2.68 ±0.56^{bcdeA}	4.03 ±0.66^{bcdeB}	5.34 ±4.06^{abcdeAB}
				(Mean ± SE*; 3rd wk**, %)					
Imported	2.11 ±1.08^{bA}	2.04 ±0.72^{aA}	0.86 ±0.48^{aA}	0.86 ±0.43^{bA}	3.45 ±0.93^{bA}	6.06 ±0.87^{bA}	1.00 ±0.56^{aA}	3.36 ±1.36^{bA}	4.98 ±1.44^{bA}
Local-1	4.02 ±1.18^{bA}	2.77 ±2.00^{Bb}	2.80 ±0.66^{bB}	1.81 ±0.40^{bA}	2.67 ±1.33^{bA}	2.83 ±0.27^{bA}	1.62 ±1.14^{bB}	6.36 ±0.95^{bA}	1.28 ±0.74^{bA}
Local-2	1.38 ±1.38^{bA}	1.06 ±0.60^{bB}	2.88 ±1.19^{bB}	3.69 ±2.07^{bA}	2.54 ±1.62^{bA}	0.92 ±0.92^{bA}	0.77 ±0.77^{bB}	1.45 ±1.45^{bA}	1.88 ±0.77^{bA}
Local-3	3.62 ±2.75^{bA}	5.13 ±2.85^{bB}	2.40 ±1.29^{bB}	5.33 ±3.21^{bA}	5.42 ±3.17^{bA}	12.34 ±4.25^{aB}	2.11 ±1.30^{bB}	3.87 ±0.56^{bA}	4.48 ±3.19^{bA}
				(Mean ± SE*; 3-wk** cum.†, %)					
Imported	37.93 ±6.43^{bcdefgA}	28.60 ±6.51^{bcdefghijA}	33.54 ±1.78^{bcdefghijA}	28.92 ±2.92^{bcdefghijA}	22.14 ±0.50^{fghijA}	38.21 ±3.77^{bcdefgA}	20.13 ±2.80^{ghijA}	32.26 ±5.06^{bcdefghiA}	39.11 ±1.91^{bcdefA}
Local-1	26.49 ±7.05^{defghijA}	25.35 ±0.38^{defghijB}	36.32 ±8.06^{bcdefgA}	35.25 ±3.66^{bcdefghB}	22.49 ±0.83^{fghijA}	42.22 ±2.55^{abcdeA}	27.28 ±2.68^{cdefghijB}	34.70 ±8.00^{bcdefghiA}	33.93 ±6.80^{bcdefghijA}
Local-2	46.92 ±7.11^{abB}	36.10 ±2.75^{bcdefghB}	19.80 ±2.56^{ghijB}	16.54 ±5.25^{ijC}	29.10 ±2.30^{bcdefghijB}	24.05 ±2.82^{efghijB}	15.81 ±3.17^{jC}	27.51 ±2.72^{cdefghijB}	19.44 ±8.30^{hijB}
Local-3	44.29 ±7.06^{abcAB}	32.15 ±8.86^{bcdefghijAB}	33.64 ±2.57^{bcdefghijAB}	32.94 ±7.87^{bcdefghijABC}	34.30 ±2.70^{bcdefghiB}	57.65 ±10.83^{aAB}	31.96 ±1.20^{bcdefghijBC}	43.60 ±7.22^{abcdAB}	33.66 ±5.12^{bcdefghijAB}

Different small alphabets on means in a row show significant differences at $p<0.05$

Different capital alphabets on means in a column show significant differences at $p<0.05$

*SE = Standard error

**WK = Week

†CM = Cumulative

Conclusion: The day-old and subsequent body weight, weight gain and feed intake were higher in imported than local flocks. The lower feed intake, better feed conversion ratio (FCR) and higher mortality rate were recorded in local-3 as compared to other flocks. The progeny secured from heavy male parent had higher hatch weight, body weight, weight gain and feed intake than those hatched from medium and small male parents, showing more pronounced effect of male parent on progeny growth and on almost all the other parameters.

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