

Effect of Non-Genetic Factors on Absolute Growth Rate in Short Term Selection for Different Ages in Japanese Quail

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Abstract: Meat type Japanese quail were subjected to three different methods of individual phenotypic selection viz., high 2 weeks body weight (SWL), 4 weeks body weight (FWL) and high 4 weeks 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 studied barring the influence of sex on body weight at hatch. The least square means of AGW during 1st-6th weeks of age were 26.38 ± 0.37 , 43.66 ± 0.64 , 37.42 ± 0.69 , 27.70 ± 0.70 , 23.76 ± 0.61 and 18.02 ± 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 ± 0.33 , 37.97 ± 0.57 , 41.06 ± 0.60 , 34.16 ± 0.61 , 25.10 ± 0.53 and 23.63 ± 0.49 g, respectively. The least squares means of AGW during 1st-6th weeks 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 ± 0.32 , 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, generation

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 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 5 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; 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, 4th-6th weeks 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 1989-1992 when the population was subjected to selection on the basis of body weight at 4 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 2 weeks of age, the other (FWL) for high body weight at 4 weeks of age. The third group (LWL) was subjected to two stage selection with the initial selection practised at 4 weeks of age for high body weight followed by selection for low relative body weight gain between 4-6 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_3 generations. Only those data of progenies with intact wing bands and whose sexes were phenotypically identifiable were included in the study. One of the four groups formed in the base generation (S_0) 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, 1960) 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 (1955)'s multiple range test was employed to make all pair wise comparisons of means.

RESULTS AND DISCUSSION

The results of least squares analysis of variance of AGW based on pooled data shown in Table 1. The overall least squares means for AGW during 1-6 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). The least squares means of AGW ranged from 26.96±0.35 g at 1st week to 37.42±0.69 g 3rd weeks and dropping steeply to 19.01±0.53 g at 6th week in SWL line. In FWL, AGW varied from 28.03±0.34 at 1st week, 40.93±0.59 g at 2nd week to 19.59±0.52 g at 6th week. AGW in LWL was 25.10±0.36 at 1st week 49.08±0.66 g at 3rd week and 17.43±0.55 g at 6th 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 3rd week in the LWL and the COL lines while in FWL, it was during 2nd and 3rd week indicating that age and method of selection might influence the

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

| | Lines | | Generations | | Sexes | | Hatches | | Error |
|-----|-------|-----------|-------------|-------------|-------|-------------|---------|------------|-------------|
| | df | MSS | df | MSS | df | MSS | df | MSS | |
| AGW | | | | | | | | | |
| 1 | 3 | 2773.38** | 3 | 6795.13** | 1 | 519.87** | 5 | 25745.89** | 5549 49.72 |
| 2 | 3 | 5899.62** | 3 | 26820.34** | 1 | 2297.48** | 5 | 9290.66** | 5549 149.17 |
| 3 | 3 | 3294.73** | 3 | 115484.44** | 1 | 9362.21** | 5 | 45551.47** | 5549 173.19 |
| 4 | 3 | 6472.73** | 3 | 27437.96** | 1 | 27455.05** | 5 | 49921.60** | 5549 177.66 |
| 5 | 3 | 3329.69** | 3 | 8542.22** | 1 | 80789.21** | 5 | 22244.90** | 5549 134.53 |
| 6 | 3 | 1625.29** | 3 | 353.17* | 1 | 153470.61** | 5 | 2924.08** | 5549 114.74 |

*Significant at $p < 0.05$; **Significant at $p < 0.01$

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 ^c | 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 ^a | 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 ^e | 2.09 | 42 | 18.35 ^d | 1.82 | 42 | 13.44 ^f | 1.68 |
| 6 | 25 | 34.90 ^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 ($p < 0.05$)

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 2nd week in S₀-S₃ while in S₂ alone, peak gain was witnessed during 3rd week.

CONCLUSION

Females had significantly ($p < 0.01$) higher values for absolute weight gain over males except during 1st week and the magnitude of difference was much wider during 5th and 6th week of age, probably as a consequence of growth of female reproductive organs as the birds approached sexual maturity. Metodiev and Drbohlav (1998) 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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