VI. SUMMARY

The present investigation was undertaken at the All India Coordinated Research Project on Poultry Breeding for Meat, Bangalore Centre, Karnataka Veterinary, Animal & Fisheries Sciences University. Three consecutive generations (S8, S9, S10) of a pedigreed synthetic colored broiler dam line, (PB2) undergoing multi-stage mass selection for juvenile body weight at five weeks of age and egg production and allied traits were evaluated with the following objectives:

1. Estimation of genetic parameters for production traits in the selected line
2. Estimation of response to selection in production traits
3. Fitting of curves for egg production up to 40 weeks of age using mathematical models
4. Comparison of relative efficiency of different models fitted to explain part term production

Information on 20898 progenies from 209 sires and 1639 dams were utilized. The data on i) Body weight at five weeks of age (BW5) ii) Body weight at 20 weeks of age (BW20) iii) Age at sexual maturity (ASM) iv) Body weight at sexual maturity (BWSM) v) Egg weight at 32 weeks of age (EW32) vi) Egg weight at 40 weeks of age (EW40) vii) Body weight at 40 weeks of age (BW40) viii) Egg production up to 40 weeks of age (EP40) ix) Egg production up to 52 weeks of age (EP52) x) 28-day Independent segments of egg production to 40 weeks of age (P1, P2, P3 and P4) and xi) Cumulative segments of egg production to 40 weeks of age (EP28, EP32 and EP36) measured on each bird were collected and generated.

Chicks were produced in four to five hatches in each generation. The data on each bird were corrected by fitting Least Square constants for subsequent analysis, since hatch and sex effects were significant. Significant differences were also observed among the generations for the traits studied in the investigation.

Heritability estimates were obtained from paternal half-sib variance component analysis on intra-generation basis. The pooled heritability estimates from sire component were 0.134 ±0.022 for juvenile body weight at five weeks of age (combined sexes), 0.247 ±0.051 for pullet body weight at 20 weeks of age, 0.289 ±0.061 for age at sexual
maturity, 0.217 ±0.056 for body weight at sexual maturity, 0.142 ±0.053 for egg weight at 32 weeks of age, 0.043 ±0.002 for egg weight at 40 weeks of age, 0.208 ±0.056 for body weight at 40 weeks of age, 0.150 ±0.049 for part term egg production up to 40 weeks of age and 0.194 ±0.018 for part term egg production up to 52 weeks of age. The males and females had pooled heritability estimates of 0.146 ±0.026 and 0.121 ±0.024, respectively for body weight at five weeks of age.

Weekly egg production data from 25 to 40 weeks of age in two generations were segmented into four independent segments namely, P1 (25-28 weeks), P2 (29-32 weeks), P3 (33-36 weeks) and P4 (37-40 weeks) of 28 days duration each and three cumulative segments namely EP28, EP32 and EP36 involving total egg production up to 28, 32 and 36 weeks of age, respectively. The pooled heritability estimates for the independent part records were 0.260 ±0.066 for P1, 0.089 ±0.046 for P2, 0.044 ±0.0141 for P3 and 0.039 ±0.041 for P4. The pooled estimates for the cumulative part records were 0.225 ±0.063, 0.179 ±0.059 and 0.159 ±0.056 for EP28, EP32 and EP36, respectively.

Juvenile body weight at five weeks of age (the primary trait of selection) showed positive genetic and phenotypic correlations of medium to high magnitude with all the subsequent body weights. Significant positive, moderate genetic and phenotypic associations were also obtained among all the subsequent body weights up to 40 weeks of age.

The relationship of body weights at all ages including the juvenile body weight at five weeks of age, with age at sexual maturity, were negative with low to high genetic correlations and low to moderate negative and positive phenotypic correlations.

Body weights at all ages except 40 weeks had low to high positive genetic associations with part term egg number up to 40 and 52 weeks of age. Medium genetic and low phenotypic negative associations were observed between egg production and adult body weight at 40 weeks of age.

Body weights at all ages, including the early body weight at five weeks of age, exhibited strong positive genetic and phenotypic associations with egg weights at 32 and 40 weeks of age.
Age at sexual maturity showed strong negative genetic and phenotypic associations with part term egg production at 40 and 52 weeks of age, while it’s relationship with egg weights at 32 and 40 weeks of age were positive and moderate to high.

Part term egg production at 40 and 52 weeks of age exhibited negative relationships of medium to high magnitude at genetic level and low to medium magnitude at phenotypic level with egg weights at 32 and 40 weeks of age. Egg production at 40 weeks of age also exhibited strong positive genetic correlations of high magnitude and phenotypic correlations of moderate magnitude with egg production at 52 weeks of age. Egg weight at different ages (32 and 40 weeks) also showed low to moderate positive relationship amongst them at both phenotypic and genetic levels.

Correlations on the genetic scale between egg production up to 40 weeks of age and the various independent and cumulative segments of egg production were generally moderate to high, greater than the respective phenotypic correlations, thereby giving a bright scope for improving the part term egg production through selection for it’s early segmented production performance. Similar moderate to high genetic and phenotypic correlations were observed between different cumulative part records and the total egg production up to 52 weeks of age, further reinstating the possibility of improving the part term production at 52 weeks of age, based on the cumulative part records up to 40 weeks of age.

The average effective population size in the strain was 246.46 and the average rate of inbreeding (\(\Delta F\)) per generation was 0.002.

The mass selection for juvenile body weight at five weeks of age resulted in an observed average increase (per generation) of 75.68 g for the combined sexes, 81.93 g for the males and 65.12 g for the females. The realized response showed an average gain of 37.95 g for males, 8.39 g for females and 22.16 g for the combined sexes, per generation. The correlated responses in all the subsequent body weights were positive and high. Age at sexual maturity showed an average reduction of 0.706 days. Egg weight at 32 weeks of age showed a gain of 0.249 g per generation. Egg weight at 40 weeks of age improved
only marginally (0.091 g). Egg number showed increases of 0.226 and 0.204 eggs, respectively at 40 and 52 weeks of age, on direct selection for juvenile body weight.

Path coefficient analysis was adopted considering egg production up to 40 weeks of age as the dependent trait, and the independently segmented periods (P1 to P4) of egg production as independent variables. It was opined that egg production during 28-32 weeks of age (P2) could effectively be used for phenotypic selection of pullets for bringing about improvement in cumulative egg production to 40 weeks of age. Direct selection for egg production during this period was expected to improve egg production to 40 weeks of age by 0.764 to 1.18 eggs.

Step-regression analysis was adopted to develop prediction equations to estimate part term egg production up to 40 and 52 weeks of age from various segments (independent and / or cumulative) of egg production, age and body weight at sexual maturity. The prediction equations recommended were:

1. \( EP_{40} = 7.1450 + 1.387 \text{ (P1)} + 0.966 \text{ (P2)} + 1.444 \text{ (P3)} \)
2. \( EP_{40} = 16.917 + 1.035 \text{ (EP36)} \)
3. \( EP_{52} = 11.904 + 1.414 \text{ (P1)} + 1.308 \text{ (P2)} + 1.420 \text{ (P3)} + 1.823 \text{ (P4)} \)
4. \( EP_{52} = 35.081 + 1.149 \text{ (EP40)} \)

The \( R^2 \) values of these equations were 82.5 per cent, 92.9 per cent, 70.2 per cent and 79.4 per cent, respectively.

The average weekly egg production from 19 to 52 weeks of age over two generations of PB2 strain and Control line was fitted using six mathematical models. The relative efficiency or goodness of fit of these models was judged on the basis of amount of variation that can be explained by the independent variable, in terms of coefficient of determination (\( R^2 \)) and chi-square test. The models identified and recommended to be the best for both the strains, based on these \( R^2 \) values were:

1. Rational Function
2. Polynomial Fit of Fourth degree

Keeping in view of the above facts, the following recommendations were suggested:
1. Mass selection may be continued to improve the juvenile body weight at five weeks of age. As the selected line has undergone considerable length of selection, a reciprocal recurrent selection programme could be adopted to improve the purebred performance utilizing information on the crossbred performance for the primary trait, provided a suitable male line is identified.

2. A multi-trait restricted selection index incorporating egg production and egg weight around the peak production phase should be utilized to improve egg number and simultaneously arrest any possible decline in egg weight.

3. It is advisable to maintain random-bred control populations of comparable size, derived from the same leading strains to assess the genetic trends and influences of environmental fluctuations accurately.

4. The egg production during 29-32 weeks of age (P2) could effectively be used for the phenotypic selection of pullets to bring about improvement in total egg production up to 40 weeks of age (EP40). Direct selection for egg production during this period would be more effective to bring about improvement in EP40, as a correlated response.

5. The regression equations constructed for egg production up to 40 and 52 weeks of age based on cumulative part records are more reliable and accurate for prediction, in comparison to those involving independent part records.

6. The mathematical models fitted and identified to explain best the average weekly egg production, are very simple and therefore recommended for the accurate determination or prediction of the same to take early management decisions.