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Research Article

HERITABILITY OF PRODUCTION AND REPRODUCTION TRAITS IN COLORED SYNTHETIC BROILER BREEDER CHICKEN OF ODISHA, INDIA

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ABSTRACT: Breeding program in Odisha was started in 1994 to improve productivity of coloured synthetic broiler breeder chicken. The pedigree in the current study descended from 69 sires and 552 dams. Genetic parameters were estimated using sire and dam component of variances for various production and reproduction traits after necessary corrections for hatch effects were done. Heritability in male was found to be 0.232 ± 0.615 for body weight at 5th week while it was high (0.718 ± 0.129) in female. Age at first egg showed a low heritability (0.127 ± 0.131) estimated from sire component and was 0.191 ± 0.336 estimated from dam component of variance. Heritability for egg numbers up to 40 weeks laying was 0.624 ± 0.439 when estimated from dam component of variance but, was negative from sire component. Heritability value for body weight at 20th week of age (male) was very high but it was low in females (0.035 ± 0.134) when estimated from sire component of variance. Egg weight had a very high heritability value (0.644 ± 0.265) but egg shape index had a low value (0.150 ± 0.240) when estimation was from sire component. The comparative r_g values among 5th week body weight, 20th week body weight, ASM, egg weight, egg production were significant ($p < 0.05$). These traits seemed to have additive effect of genes and utilizing them as selection traits would improve both egg production and growth performance of breeder broiler chicken.

Key words: Breeder chicken, Heritability, Production, Reproduction, Genetic correlation.

INTRODUCTION

Poultry rearing, an important subsidiary of Indian agriculture plays a significant role in uplifting rural economy. Poultry industry is the fastest growing sub sector contributing 2% to the total GDP (Narahari and Sapcota 2009). Nutritive value, low fat and cost effectiveness compared to other sources of animal proteins has made poultry meat an important protein source in Indian subcontinent. An ideal broiler

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strain has to be evolved to make Indian poultry industry self reliant. Genetic and phenotypic parameters such as mean, variance, heritability, genetic correlation and phenotypic correlations play a vital role to develop a broiler strain (Panda 2009). Selection programme can utilise these values in order to bring about changes in genetic properties of a broiler population (Falconer 1981). Heritability estimates are indicators of additive genetic variances existing in a population. Production and reproduction traits are fundamental corner stone in enhancing the efficiency of the breeder chicken. Body weight at different ages is important for general health of birds which in turn influences efficiency of egg production (Dana *et al*., 2011). Similarly, age at sexual maturity, egg number, egg weight and egg shape indices are central towards selection of a broiler breeder strain. Literature on heritability on production and reproduction traits in coloured synthetic broiler breeder chicken of Odisha is very rare. The present study was, therefore carried out to know the heritability estimates of these traits which can help improving the breeder strain in a continuous selection programme.

MATERIALS AND METHODS

The data utilised in the present investigation were collected between January, 2011 to February, 2012 from a synthetic broiler female line maintained at All India Coordinated Research Project on Poultry for meat located at the College of Veterinary Science and Animal Husbandry, Bhubaneswar, Odisha, India. Six hundred thirty progenies were obtained from 69 sires and 552 dams produced in four consecutive hatches at an interval of 10 days. The birds were reared in individual cages after attaining 20 weeks of age. Traits considered for present study were: body weight (g) of males and female at 5th and 20th weeks of age; age at sexual maturity (days) of female birds; egg number laid up to 40 weeks of age; egg weight (g); and egg shape index. Each data was corrected for hatch effect as per Danell (1990). Corrected data = X ± ($\overline{X_i} - \overline{X}$); Where X= individual observation under ith hatch, $\overline{X_i}$ = mean of ith hatch, $\overline{X}$ = overall mean of all hatches. If, ($\overline{X_i} - \overline{X}$) is negative, then ($\overline{X_i} - \overline{X}$) value is to be added to the data (X). If, ($\overline{X_i} - \overline{X}$) is positive then, ($\overline{X_i} - \overline{X}$) value is to be deducted from the data. Heritability along with its standard error for each trait was estimated using sire and dam component of variances (Becker 1975). Genetic, phenotypic and environmental correlations were estimated from variance and covariance components of analysis from sire source only (Becker 1975).

The linear statistical model for estimation of heritability was : $Y_{ijk} = \mu + S_i + D_{ij} + e_{ijk}$, where dams were nested in sires. Y_{ijk} = observation of kth progeny of jth dam mated to ith sire, S_i = effect of ith sire, D_{ij} = effect of jth dam mated to ith sire, e_{ijk} = random error associated with Y_{ijk} . $h_s^2 = 4\sigma_s^2 / (\sigma_s^2 + \sigma_d^2 + \sigma_e^2)$ and $h_d^2 = 4\sigma_d^2 / (\sigma_s^2 + \sigma_d^2 + \sigma_e^2)$ where, h_s^2 = heritability from sire component, h_d^2 = heritability from dam component, σ_s^2 = sire component of variance, σ_d^2 = dam component of variance, σ_e^2 = error variance.

RESULTS AND DISCUSSION

Heritability estimate from sire component of variance is an appropriate measure as compared to other components and is not augmented by environmental effect. However, the standard errors of heritability estimates are high (Falconer 1981). The present finding is also in close agreement with that of Falconer

Table 1. Heritability estimates of various traits of coloured synthetic broiler breeder chicken.

Traits	n = number of observation	h_s^2 ± S.E.	h_d^2 ± S.E.
Body weight at 5th week of age (male)	194	0.232 ± 0.615	1.763 ± 1.222
Body weight at 5th week of age (female)	512	0.718 ± 0.129	-4.273 ±0.910
Body weight at 20th week of age (male)	194	0.813 ± 0.391	0.404 ± 0.906
Body weight at 20th week of age (female)	512	0.035 ± 0.134	0.786 ± 0.349
Age at sexual maturity (female)	512	0.127 ± 0.131	0.191 ± 0.336
Egg weight	308	0.644 ± 0.265	-0.104 ± 0.486
Egg number	427	-0.259 ± 0.126	0.624 ± 0.439
Egg shape index	308	0.150 ± 0.240	0.848 ± 0.539

h_s^2 = heritability from sire component of variance.
h_d^2 = heritability from dam component of variance.

(1981). Heritability for growth characteristics is quite high in the order of 0.4-0.6 which is achieved by selecting heaviest birds as breeders. In contrast, reproductive traits are reported to have much lower heritability of 0.05 - 0.20 as documented by Leeson and Summer (2009). The heritability of body weight at certain ages ranged between 0.2 and 0.8 *i.e.* medium to high confirm the result of present study which is in close consonance with Rendel (1991) (Table 1). Annual Report of Indian Council of Agricultural Research (Anonymous 2006-07), revealed the heritability estimates for 5th week body weight moderate to high.

The high value of 5th week body weight (males) in dam component indicated the existence of maternal effect and involvement of non additive genes along with sex linkage for the inheritance of this trait. Heritability for 5th week body weight (female) from dam component of variance (h_d^2) was found to be - 4.273 ±0.910 which might be attributed to absence of sex linkage, maternal effect and non additive gene effect. The heritability value from sire component was high (0.718 ± 0.129) and hence, 5th week body weight in females may be used fairly as a best selection criterion for broiler breeder hens.

Estimates for 20th week body weight (males and females) in the present study are in line

Table 2. Genetic, phenotypic and environmental correlations between different traits and their standard errors.

Correlation between	r_g	r_p	r_e
5th week body weight and 20th week body weight (male)	0.689* ±0.639	0.150* ±0.141	-0.354*
5th week body weight and 20th week body weight (female)	-1.726* ±0.009	0.257* ±0.076	0.493*
5th week body weight and Age at sexual maturity (female)	1.176* ±0.006	-0.027 ±0.092	-0.267
5th week body weight and egg weight (female)	0.123 ±0.112	0.091 ±0.100	0.077
5th week body weight and 40 week egg production (female)	-0.636* ±0.018	-0.024 ±0.088	0.157
5th week body weight and egg shape index (female)	0.270 ±0.024	0.089 ±0.083	0.046
20th week body weight and ASM (female)	5.524* ±9.338	-0.296 ±0.076	-0.658*
20th week body weight and egg weight (female)	0.344* ±2.116	-0.083 ±0.106	-0.175
20th week body weight and 40 week egg production (female	3.300* ±6.394	0.143 ±0.091	-0.141
20th week body weight and egg shape index (female	3.317* ±5.354	-0.055 ±0.088	-0.310
ASM and egg weight	-0.438* ±0.568	-0.015 ±0.120	0.117
ASM and 40 week egg production	-0.614* ±0.118	-0.189 ±0.101	-0.120
ASM and egg shape index	-1.964* ±0.448	-0.080 ±0.100	0.178
Egg weight and 40 week egg production	-0.615* ±0.031	-0.022 ±0.108	0.255
Egg weight and egg shape index	12.352* ±6.336	0.228 ±0.097	-4.430*
40 week egg production and egg shape index	-0.749* ±0.032	-0.052 ±0.094	0.090

*p<0.05

with the values obtained by Sethi *et al*. (2003) who has also accounted for the presence of additive genetic effect, similar to our findings. However, the heritability values calculated by Niranjan *et al*. (2013) were of moderate nature only for this trait. Thus, 20th week body weight (males and females) can also be included in the continuing selection programme of broiler breeder chicken. Age at sexual maturity is moderately heritable in chickens in our study confirms the findings of Ideta and Siegel (1996) and Niranjan *et al*. (2013). Heritability value for egg weight in sire component was high (0.644 ± 0.265) whereas it was - 0.104 ± 0.486 in dam component and hence, the additive effect exists with this trait which may respond well to selection. Ghazikhanishad *et al*. (2007) reported a low to moderate h^2 value for egg number which supports the present value obtained in the sire component of heritability.

The high value from dam component in the present study signals the existence of some maternal and non additive gene effect. The values of heritability for egg number and egg shape index were similar and low following calculation from sire component of variance whereas it was recorded to be high when calculated from dam component of variance. Hence, selection for these traits might not respond well.

The 5th week body weight correlates positively with 20th week body weight in males both genetically and phenotypically and also significantly ($p<0.05$). High positive correlation between these two traits suggested that most of the genes that influence the inheritance of 5th week body weight in males also influence the inheritance of 20th week body weight. The values obtained in the present study are in close agreement with that of Dev Roy (1986). Again testes growth in male is linearly correlated with age and body weight at prepubertal phase *i.e.* birth to 10 week (Vankrey 1990). So a male with higher body weight at 5th week might produce better semen at sexual maturity.

In females, the genetic correlation was significant ($p<0.05$) and negative (-1.726) between 5th and 20th week body weight (Table 2). On the contrary, the phenotypic correlation is also significant ($p<0.05$) and positive (0.257). Genetically the heavy female birds at 5th of age are the lightest one at 20th week age but environment plays the role to maintain the body weight. This may be attributed to channelization of body reserves towards preparation for production at 20th week of age. The genetic correlation between 5th week body weight and ASM was significant ($p<0.05$) which indicated high 5th week weight delays ASM genetically although environment plays a role in negating this effect that leads to decrease in ASM.

The genetic correlation between 20th week body weight and ASM was high (0.84 and 0.70) as reported by EI-Labban *et al*. (2011) and Nwagu *et al*. (2007) whereas the present study calculated r_g >1 and significant ($p<0.05$). Our study demonstrated that the environments like nutrition, temperature, etc. might be responsible in playing a vital role in decreasing the ASM (Leeson and Summer 2009). It would be interesting to note that genetically heavier birds at 20 weeks of age might require more number of days to attain maturity.

An r_g value of 0.694 between 20th week body weight and egg weight corroborates that of Johri (1983). It revealed that the heavier birds at 20 week of age lay comparatively heavier eggs. The optimum body weight at 20 week of age provides a better environment to develop the reproductive organs of birds leading to more egg production (Rendel 1991). The values of present study support the reports of Jaap *et al*. (1962).

A typical but interesting finding was observed in the present study between ASM and egg shape index suggesting, earlier the ASM, more ovoid (more breadth) is the egg (Table 2). Further, when there is increase in egg weight, the breadth is also increased which is in line with Rendel (1991) and Singh (2000).

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