GENETIC PARAMETER ESTIMATES FOR EIGHT WEEK BODY WEIGHT IN A FOUNDATION STOCK OF MALE LINE BROILER CHICKENS

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ABSTRACT

The objectives of this study were to estimate heritabilities and genetic correlations for eight week body weight in a foundation stock of male line broiler chickens. A total of 2,086 birds comprising 1500 hens and 586 cocks were used in 3 generations. At hatch, chicks used were wing-banded, weighed and housed on deep litter. Body weights of birds were subsequently taken at 2, 4, 6 and 8 weeks of age. For each generation, data obtained were utilized to estimate heritabilities, genetic and phenotypic correlations from sire component of variance. Selection action (Sel action) statistical software was used to estimate heritability, genetic and phenotypic correlations. Correlations were moderate to high. Heritability estimates for generation 1 ranged from moderate to high 0.34 (CW2) to 0.75 (CW8), low to high for generation 2 (0.17) for CW0 and (0.88) for CW8 and positively low for CW0 to high for CW8 (0.16 to 0.81) for generation 3. This points to the existence of an appreciable amount of additive genetic variance in the flock and indicates that improvement in the traits can be brought about by intrapopulation selection. The high and positive genetic and phenotypic correlations indicate the pleiotropic action of genes controlling these traits, and that by direct selection for anyone of them; genetic improvement in the others will be realized as correlated responses.

Key words; broiler male line, foundation stock, Heritability

INTRODUCTION

Genetic progress for body weight in chickens has been accomplished by continuous selection. In meat-type chickens, genetic parameters of growth have been well investigated. This information becomes more relevant especially in flocks that undergo selection, in view of the fact that continued selection tends to bring about change in the genetic correlations among traits (Sharma and Krishna, 1998). Moderate heritability for body weights of naked neck broilers at various ages was reported by Adeyinka *et al.* (2006). They observed high heritability estimates for body weight at 56 days of age and finally suggested that selection for body weight at this age will improve body weight in subsequent generations. Ardeshir *et al.* (2012) reported heritabilities of 0.56± 0.012, 0.44± 0.02 and0.51 ±0.02 for body weight at day old, 8 weeks and 12 weeks respectively in their work on Iranian native chicken under short term selection. Yahaya *et al.* (2012) obtained genetic correlation between body weight at 8 weeks and body conformations. Shank length, keel length, breast width, back length and neck length of 0.9416, 0.894, 0.861, 0.897 and 0.963 in the Hubbard broiler strain, while for Arbor acre strain, the correlation of 0.967, 0.974, 0.882, 2.935, 0.981 and 0.969 were obtained between body weight and back length, shank length, thigh length, keel length, breast width and back length respectively. The objectives of this study were to estimate heritabilities and genetic correlations for eight week body weight in a foundation stock of male line broiler chickens kept at the National Animal Production Research Institute.

MATERIALS AND METHODS

The research was conducted at the Poultry Breeding Unit of the National Animal Production Research Institute (NAPRI) Shika, Zaria. Birds used for the work were the male line foundation stock of broiler chickens of the poultry breeding unit. Mating ratio was 1 cockerel to six hens. Eggs were picked on daily basis and identified by the sire number and taken to the hatchery. Eggs were sorted sire wise before setting. Chicks were weighed individually within 24 hours of hatching using a digital weighing balance and recording their individual body weights and wing tagged for easy identification. A total of 2,086 birds were used in 3 generations. The deep litter system of management was used to rear the birds from day old to 8 weeks of age. A starter ration was fed *ad libitum* during the first four weeks. Feed was changed to broiler finisher for the next four weeks of the study. Growing birds were kept on restricted

feeding programme, from 9 to 20 weeks of age to minimize fat accumulation and maximize egg production. Vaccination schedule for broilers was strictly adhered to.

Data Transformation

Data was corrected for hatch effect, using the following mathematical model

$Y_{ij}=\mu+h_i+e_{ij}$

Where, Y_{ij}=measurement of a trait on the j^{th} individual of the i^{th} hatch; μ= common or overall mean; h_i= effect of the i^{th} hatch, and e_{ij}= random error assumed to be normally and independently distributed with mean= 0 and variance $\sigma^2 e$

Data analysis

Selection action (Sel action) statistical software was used to estimate heritability, genetic and phenotypic correlations.

RESULTS AND DISCUSSIONS

Table 1 shows heritability values, matrix of genetic and phenotypic correlations for bodyweight traits of male broiler line in generation 1. Heritability estimates ranged from 0.34 (CW2) to 0.75 (CW8) within the bodyweight traits. CW0, CW4, CW6 and CW8 (0.48, 0.61, 0.47 and 0.75) had high and positive heritability loadings respectively. The magnitude and distribution was moderate to high. Positive correlations were observed between genetic and phenotypic associations with varying magnitude and level of significance in both directions. Bodyweights had high and significant ($p<0.05$) relationship for both phenotypic and genetic correlation except in genetic correlation where non-significant ($p>0.05$) difference and low association were observed between CW2 and CW4 (0.14). Table 2 shows the heritability and correlations in the second generation. Values ranged from low (0.17) for CW0 to high (0.88) for CW8. The values obtained for CW4, CW6 and CW8 were high (0.59, 0.52 and 0.88). Generally, genetic and phenotypic correlations varied widely in both magnitude and directions among bodyweight traits, while it ranged from low (0.04) between CW0 and CW6 to high (0.89) between CW0 and CW8 for genetic correlations. All the relationships differed significantly ($p<0.05$) within bodyweight traits except for correlations between CW2 and CW4 (0.19) and CW4 and CW8 (0.34). Positive phenotypic correlations ranged from moderate (0.40) between CW8 and CW2 to high (0.90).

Table 3 presents the heritability estimates, genetic and phenotypic correlations for bodyweight traits of male line broiler in generation 3. Heritability estimates were positively low for CW0 to high for CW8 (0.16 to 0.81). Genetic correlation was highly heterogeneous which ranged from low (0.10) between CW0 and CW2 to high (0.89) between CW6 and CW8. Non-significant ($p>0.05$) correlations were observed between CW0 and CW2 (0.10) and CW0 and CW4 (0.26). Phenotypic correlations had positive and significant ($p<0.05$) associations for bodyweight traits within different ages except for CW6 and CW8 (0.22) which did not differ significantly ($p>0.05$). Generation wise, the moderate to high and low to high heritability estimates in generation one for both bodyweights from CW0 to CW8 of the flock was in agreement with the submissions of wide range of heritability that has been reported by some researchers in broilers at different ages (El–Fiky, 2005 and Abdel-Fattah, 2006) who studied body weight at different ages and used different methods to estimate the heritability. Differences in estimated values for heritability in this study compared to reported values by some researchers could be due to uniqueness of the population, the selection environment, and the period and length of selection (generations). This is an indication that considerable improvement in this trait could be achieved through efficient selection programs. The low to high estimates obtained in generation 2 implies that body weight traits are controlled by the same additive gene action. This trend has been reported by Abdel-Seoud, 2008and Magda *et al.* (2010). Differences in heritability estimates could be attributed to method of estimation, strain, environmental effects and sampling error due to small data set or sample size. Akanno and Ibe (2005) reported that low and moderate heritability estimates could be improved upon by combining pedigree and individual selection records. Estimates of heritability were not consistent as the age increased. Significant, non-significant and low to high positive genetic correlations between growth traits obtained in this study for the three generations confirm literature reports (Abdel-Seoud, 2008) and implies that for traits with positive and high genetic correlation, selection for one trait will lead to improvement in the other. This however, is the phenomenon of correlated response. This, therefore, provides a

basis for the genetic manipulation and improvement of the broiler stock. Positive association was observed among all the traits within generations. This agrees with the report of Magda *et al.* (2010) who reported positive phenotypic correlations in selected lines of broiler birds. Low phenotypic correlations obtained in the flock at the third generation between CW8 and CW6 (0.22) indicate that variation observed in one trait contributes only slightly to the variation observed in the second trait Therefore, since broiler chickens are kept mainly for meat , attaining mature body size at earlier ages is the target of the production system, and thus, selection at 8 weeks of age could be the most suitable approach to improve growth.

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Table 1: Heritability (h^2), Matrix of Genetic (below diagonal) and Phenotypic (above diagonal) correlation for bodyweight traits of broiler male line at generation 1

Traits	h^2	CW0	CW2	CW4	CW6	CW8
CW0	0.48±0.06	1	0.65**	0.78**	0.83**	0.77**
CW2	0.34 ±0.13	0.46**	1	0.88**	0.67**	0.66**
CW4	0.61±0.004	0.83***	0.14^{ns}	1	0.84**	0.84**
CW6	0.47±0.002	0.64**	0.75**	0.64**	1	0.93**
CW8	0.75±0.15	0.72**	0.59**	0.89**	0.96**	1

CW0- 8: Corrected Weight from day old to eight weeks h^2 – Heritability

Table 2: Heritability, Matrix of Genetic (below diagonal) and Phenotypic (above diagonal) for bodyweight traits of broiler male line at generation 2

Traits	h^2	CW0	CW2	CW4	CW6	CW8
CW0	0.17±0.001	1	0.56***	0.77***	0.56*	0.54*
CW2	0.32 ±0.08	0.76***	1	0.73***	0.90***	0.40*
CW4	0.59±0.03	0.58*	0.19^{ns}	1	0.66**	0.68**
CW6	0.52±0.07	0.04ns	0.46*	0.83***	1	0.81***
CW8	0.88±0.05	0.89***	0.62***	0.34^{ns}	0.63***	1

CW0- 8: Corrected Weight from day old to eight weeks h^2 - Heritability

Table 3: Heritability, Matrix of Genetic (below diagonal) and Phenotypic (above diagonal) for bodyweight traits of broiler male line at generation 3

Traits	h^2	CW0	CW2	CW4	CW6	CW8
CW0	0.16±0.004	1		0.69***	0.78***	0.85***
CW2	0.44±0.008	0.10^{ns}	1	0.83***	0.88***	0.73***
CW4	0.41±0.12	0.26^{ns}	0.81**	1	0.64***	0.65***
CW6	0.75±0.06	0.88***	0.54*	0.83***	1	0.22^{ns}
CW8	0.81±0.009	0.84***	0.68***	0.74***	0.89***	1

CW0- 8: Corrected Weight from day old to eight weeks h^2 - Heritability