GENETIC AND PHENOTYPIC ASSOCIATIONS OF JUVENILE BODY WEIGHTS AND EGG PRODUCTION TRAITS IN TWO STRAINS OF RHODE ISLAND CHICKENS

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ABSTRACT

Data on body weight at 16 (WT16); 20 (WT20) weeks of age and at sexual maturity (WTSM), weight of first egg (WT1st), age at sexual maturity (ASM) and 120-d egg production (EN) were used to estimate genetic parameters in 636 hens of two strains of Rhode Island chikens. There were significant (P.01) differences between the two strains for all traits except for WTSM. The heritability estimates obtained ranged from 0.05 to 0.41 and 0.04 to 0.30 for strains 1 and 2 respectively. The genetic correlations obtained for the various traits were medium to high for the two strains. The phenotypic correlations were generally low but followed the same trend. The results indicate that selected stocks of the two strains would show improvements in egg production and age at sexual maturity if juvenile body weight (WT20) is employed as a selection criterion at housing for laying hens.
Key words:- Rhode Island chickens; Body weight; Egg production; Correlations

INTRODUCTION

There are a large number of commercially important traits in layer type chickens with very complex interrelationships. The number of important traits has increased over time and emphasis on the traits used in selection of breeding stocks has varied due to changes in their economic importance. However, the primary trait in layer stocks has always been egg production (Mcmillian *et al.*, 1990).

Economically, it would seem sound to select for the smallest bird which lays the largest eggs most rapidly, but biologically, this seems doubtful (Hogsett and Nordskog, 1958). Since a breeder would need to consider many traits in a selection program, the issue of negative genetic correlations must be noted, otherwise, intense selectior on one trait may cause depression in another. Therefore, the economic significance of the reproductive capabilities of laying hens justifies and encourages the study of the mode of inheritance of egg production and the relationship with variables associated with this trait. Such information is also helpful in the formulation of programs for the selection and improvement of laying flocks, and in predicting the direct and correlated responses due to selection.

This study reports on the estimates of genetic parameters obtained for juvenile body weight and egg production traits in a population of egg type breeder hens.

MATERIALS AND METHODS

Stocks:- The hens used for this study were from 2 strains of Rhode Island chickens selected for egg number at the National Animal Production Research Institute, Shika. Data from 295 pullets, progenies of 19 sires and 125 dams, for strain 1, and 341 pullets, progenies of 17 sires and 138 dams, for strain 2 were used to estimate the various parameters. The details of the composition and the management of flocks have been described elsewhere (Oni, *et al.*, 1990).

Traits measured:- Individual body weights (g) were obtained at 16 and 20 wks of age without fasting. Body weight was also obtained for each pullet on the day of first egg (i. e. sexual maturity). Age at sexual maturity was defined as the number ofdays after hatching when the first egg was laid provided that a 2nd egg was laid by that pullet within the next 0/days (Dunnigton and Siegel, 1984). Similarly, weight of 1st egg for each pullet was recorded. Number of eggs (EN) to

120-d of production from 1st egg was monitored for each hen.

Statistical analysis:- Traits listed above were analysed by ANOVA to ascertain differences between the 2 strains. A one-way random model was used to estimate the variance/covariance components by Henderson's method 1 (1953), from which the heritabilities and correlations were derived.

RESULTS AND DISCUSSION

Means and standard deviations for all the traits investigated are shown in Table 1 for the two strains. The juvenile body weights (WT16 and WT20) were significantly higher for strain 1 than for strain 2 pullets. Similarly, the strain 1 pullets reached sexual maturity at a significantly ($P < .001$) younger age than the strain 2 pullets. This suggests that the latter lacked sufficient body weight to begin egg production at that age. In other words, they matured at a later (heavier) weight, as evident by the body weight at sexual maturity for the two strains (Table 1). Similar observations have been made by Dunnigton and Siegel (1984) in egg-type White Leghorn chickens, who reported that egg-type chickens must reach a minimum age and body weight before they can commence egg production. Thus, strain 1 (early maturers) achieved the threshold level for body weight and commenced egg production when the minimum age was reached; while strain 2 (late maturers) reached the age but not the body weight to begin egg production. Although these phenomena are general, specific values of age and body weight for populations are unique. The values are subject to modification by other factors, such as feeding programs and other management practices.

TABLE 1. MEANS ($\overline{X}$) AND STANDARD DEVIATIONS($\pm$S.D.) FOR BODY WEIGHT AND EGG PRODUCTION TRAITS IN TWO STRAINS OF RHODE ISLAND CHICKENS.

	Strain 1		Strain 2	
Traits	X	s.d.	X	s.d.
WT16	1070.6	185.9^a	981.2	166.0^b
WT20	1301.5	171.9^a	1242.2	157.4^b
WTSM	1893.6	182.7^a	1914.3	194.8^a
WTIST	43.7	5.0^a	46.6	5.8^b
ASM	180.6	12.3^a	186.5	10.8^b
EN	82.4	12.1^a	78.4	12.6^b

TABLE 2. ESTIMATES OF HERITABILITY FOR PRODUCTION TRAITS.

Traits	Strain 1	Strain 2
WT16	0.413 ± 0.011	0.044 ± 0.005
WT20	0.387 ± 0.011	0.297 ± 0.009
WTSM	0.045 ± 0.006	0.148 ± 0.007
WTIST	0.102 ± 0.007	0.090 ± 0.006
ASM	0.373 ± 0.011	0.224 ± 0.007
EN	0.133 ± 0.007	0.215 ± 0.008

The heritability estimates for the various traits are shown in Table 2. The heritabilities for ASM and EN agreed with estimates reported in literature (Kinney, 1969; Acharya *et al.*, 1969; Das *et al.*, 1982; Krishna and Chaudhary 1987). The estimates obtained for WTSM, WTIST and EN were low while those for WT16, WT20 and ASM were moderate except for WT16 in strain 2. This indicated that the latter traits exhibited more genetic variance in the flock for faster improvement.

The estimates of genetic and phenotypic correlations between the various traits are given in Tables 3 and 4, respectively. The correlations among the different production traits indicated that the genetic correlations were always larger than the phenotypic correlations, although they both follow the same trend for the 2 strains.

The genetic and phenotypic correlations between ASM and WTSM were all positive for both strains (Tables 3 and 4) indicating that late maturers were heavier in weight due to both genetic and non-genetic causes (Hussain and Singh, 1964; Krishna and Chaudhary, 1987).

The genetic correlations between EN and WTSM, and EN and ASM were negative for

TABLE 3. GENETIC CORRELATIONS BETWEEN PRODUCTION TRAITS IN STRAIN 1 (ABOVE DIAGONAL) AND STRAIN 2 BELOW DIAGONAL)

Traits	WT16	WT20	WTSM	WT1ST	ASM	EN
WT16		0.88*	-0.13	-0.11	-0.85	0.46*
WT20	0.98*		0.38*	-0.06	-0.06	0.39*
WTSM	0.32*	0.33*		0.92*	0.92*	-0.77*
WTIST	-0.90*	-0.48*	0.51*		0.49*	-0.63*
ASM	-0.96*	-0.41*	0.39*	-0.03		-0.98*
EN	-0.94*	0.54*	0.24	-0.53	-0.47*	

*P < 0.05

TABLE 4. PHENOTYPIC CORRELATIONS BETWEEN PRODUCTION TRAITS IN STRAIN 1 (ABOVE DIAGONAL) AND STRAIN 2 BELOW DIAGONAL).

Traits	WT16	WT20	WTSM	WT1ST	ASM	EN
WT16		0.77*	0.25	-0.09	-0.44*	0.20
WT20	0.17		0.32*	-0.05	-0.45*	0.19
WTSM	0.08	0.29		0.13	0.24	0.02
WTIST	0.03	-0.02	0.22		0.33*	-0.24
ASM	-0.08	-0.34*	0.15	0.15		-0.39*
EN	-0.05	0.14	0.10	-0.13	-0.29	

*P < 0.05

strain 1. Therefore, as selection for high EN progresses in this strain, the pullets will mature early at a lower body weight. However, for strain 2, the genetic correlation between EN and WTSM was positive though EN and ASM had a negative correlation. Hence, as selection for EN continues in this strain, the pullets will mature at a heavier weight relative to strain 1. Consequently, the ASM would also be higher than in strain 1 (Table 1). The positive correlations between EN and WTSM in strain 2 indicated that with increasing WTSM, egg production (EN) in the subsequent 120-d period increased. The reports in the literature on the relationship between EN and WTSM are conflicting. But as stated earlier, it appears that every flock has an optimum range of body weight at sexual maturity. It has been reported (Krishna and Chaudhary, 1987) that if the average body weight at sexual maturity of the flock falls below the optimum level, its relationship with egg production would be positive. On the other hand, if it exceeds the optimum level, the relationship would be negative.

The genetic and phenotypic correlations between ASM and EN in the 2 strains showed that early maturing pullets were better producers in the 120-d production period, due to both genetic and non-genetic causes (Johari *et al.* 1985; Nayak and Mishra, 1985; Krishna and Chaudhary, 1987).

The negative correlations between ASM and juvenile body weights (WT16 and WT20) indicated that early maturers in both strains grow faster and thus tend to be heavier at 16 and 20 weeks of age. Similarly, the positive genetic correlations between EN and juvenile body weights suggest that preliminary culling could be made at housing, using pullet body weight at week 20.

The positive correlations between ASM, WTSM and WTIST in the 2 strains (Tables 3 & 4) showed that late maturing pullets are heavier and tend to lay bigger eggs at sexual maturity than early maturers. Thus, it was not suprising that strain 2 pullets had higher WTSM and WT1ST than strain 1 since the former matured later (Table 1).

The results of this study clearly indicate that juveline body weights could be incorporated in selection programmes for the genetic improvement of the 2 strains of breeder hens without any detrimental effect on EN or ASM.

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