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Short Communication

Estimation of genetic parameters of various economic traits in a closed population of female line layer type chickens under short term selection

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Abstract: The genetic parameters for various traits of economic importance were studied in a female line of chicken population under short term selection for egg production for over 2 years. The parameters studied were body weight at 20 (BW20) and 40 weeks (BW40), egg weight (EWT) and egg 280 days; and they showed mostly moderate to high heritability estimates. All these values were 0.16 to 0.78, 0.11 to 0.23, 0.42 to 0.66 and 0.25 to 0.62 respectively. Higher heritability estimate were obtained from the sire component for BW20 (0.78), BW40 (.23) and egg 280 days (0.62). However, a higher estimate was obtained from the dam component for EWTAV (0.66). Body weight at 20 weeks of age shows positive genetic and phenotypic correlations with BW40 (0.77 and 0.28) and egg 280 days (0.51 and 0.02). BW40 had positive genetic and phenotypic association with EWT (0.12 and 0.23) and egg 280 days (0.68 and 0.20). However, EWT showed negative genetic as well as phenotypic correlation with egg 280 days (-0.15) and (-0.09).

Keywords: Genetic parameters, closed flock, female line, layer type chickens, selection.

تقدير المعايير الوراثية لعدد من الصفات الاقتصادية في خط الدجاج البياض تحت ظروف الانتخاب قصير المدى

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الملخص: شمل هذا البحث تقدير المعايير الوراثية ذات العلاقة بإنتاج البيض لخط دجاج بياض وشملت الدراسة الصفات التالية: وزن الجسم عن عمر 20، 40 إسبوع، وزن البيض، إنتاج البيض خلال 280 يوم. وتراوحت قيمة المكافئ الوراثي لهذه الصفات مابين المتوسط والمرتفع، حيث كانت قيم المكافئ الوراثي على النحو التالي : 0.78 لوزن البيض عند 20 أسبوع، 0.23 لوزن البيض عن عمر 40 أسبوع 0.62 لإنتاج البيض عند فترة 280 يوم باستخدام طريقة مكونات الآباء (الذكور) بينما كانت قيمة المكافئ الوراثي مرتفعة الصفة وزن البيض (0.66) باستخدام طريقة مكونات الأمهات . وأظهرت نتائج الدراسة وجود ارتباط ظاهر ووراثي موجب لوزن البيض عند عمر 20 أسبوع مع كل من وزن الجسم عند عمر 40 أسبوع وإنتاج البيض عند فترة 280 يوم. أيضا وجد أن هناك ارتباط ظاهري وراثي موجب بين وزن الجسم عند عمر 40 أسبوع مع إنتاج البيض عند فترة 280 يوم، وبالمقابل، كان هناك ارتباط ظاهري ووراثي سالب بين وزن البيض وإنتاج البيض عند فترة 280 يوم.

الكلمات المفتاحية: المعايير الوراثية، قطيع مغلق، دجاج بياض، انتخاب.

Introduction

Poultry breeding involves populations in which gene frequencies are influenced by selection. The genetic change as a result of selection is manifested by the change in the heritability estimates. The evidence of

changes in the genetic constitution of a population under selection is manifested by changes in phenotypic performance Chatterjee et al. (2000). Correlations permit prediction of direction and magnitude of change in the dependent trait as a correlated response to direct selection of the principal trait (Laxmi et al., 2002). Thus correlations are of great interest to the breeder. The extent and direction of correlated selection response are determined by the genetic correlation or covariance between the concerned traits (Verma et al., 1983). Therefore, for improving the total economic value of an animal, it is important to know both the effect of the trait actually being selected and its effect on the other traits. 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). Wei and Vander Werf (1995) reported higher heritability estimate of 0.54 to 0.74 in egg laying chickens using a multivariate sire model. In a study with White Leghorn strains, Singh et al. (1992) reported that egg number had a negative genetic and phenotypic correlation (-0.789 ±0.45) and (-0.154 ±0.017) with egg weight and a positive genetic and phenotypic correlatin with body at 20 and 40 weeks (0.249 ±0.94 and 0.22 ±0.017 respectively) of age. Higher pooled heritability estimate from the sire (0.23 ±0.04) than from dam (0.18 ±0.08) and sire plus dam (0.16 ±0.03) components were reported previously (Oni et al. (2000) and Nwagu (2004)). Also, negative phenotypic correlation between egg weight (-0.13 and 0.18) with egg number in two strains of chicken was observed by Oni et al. (1992). In a strain of White Leghorn under reciprocal recurrent selection, there has been a higher pooled heritability estimate from dam (0.55 ±0.07) than from the sire (0.22 ±0.06) and sire plus dam (0.41 ±0.04) components of variance (Bais et al., 1997). A heritability estimate of 0.55 ±0.16 and 0.37 ±0.13 for body weight at 20 and 40 weeks respectively was reported by Rahman et al. (2003), as well as a high positive genetic (0.74) and phenotypic (0.54) correlation between the traits (Rahman et al., 2003).

The objective of this study is to estimate genetic parameters (heritability, genetic and phenotypic correlations) among the economic traits in a flock of female line layer type chicken kept at the National Animal Production Research Institute.

Materials and Methods

The study was carried out at the National Animal Production Research Institute (NAPRI), Shika, Zaria from the year 2004 to 2006. Shika is located within the guinea savannah ecological zone of Nigeria. The data used in this study were obtained from a random bred population of pedigreed female line breeder corks and hens, which form part of the poultry breeding flock maintained at the Institute. Selection was practiced for egg production up to 280 days using a family index that took into account the individual performance plus dam and sire family averages for pullets and dam and sire family averages for cockerels (Osborne, 1957 a,b). The average numbers of sires and dams used were 8 and 71, respectively; and the average number of birds studied was 210. The birds were maintained under uniform managemental conditions as far as possible. At 20 weeks of age, the pullets were housed in individual cages, from where each pullet was weighed at 20 and 40 weeks of age. Egg number upto 280 days of age was calculated for individual pullets. Three eggs per pullet were weighed at 40 weeks of age to determine average egg weight for each pullet. Where hatch was found to have a significant effect, the data was corrected for hatch effect using least square

procedures described by Harvey (1987). Genetic parameters were estimated by Mixed Model Least Squares and Maximum (LSMLMW) where by the variance components were partitioned in to those of the sire, dam and sire plus dam (Harvey 1990). The model fitted was of the nested design. The genetic and phenotypic correlations between two traits were estimated from variance and covariance component analysis as per Becker (1984).

Statistical model

$$Y_{ijk} = \mu + S_j + d_{(k)} + e_{ijk}$$

Where; Y_{ijk} is the record of the i^{th} progeny of the k^{th} dam mated to the j^{th} sire.

μ = the common mean

S_j = the effect of the j^{th} sire

$d_{(k)}$ = the effect of the k^{th} dam mated to the j^{th} sire

eijk = random error

Results and Discussion

The heritability estimates for economic traits studied are presented in Table 1. The results reveal moderate to high estimates which were in agreement with the reports of Wei and Van der Werf (1995), Chaudhary et al. (1996), Sharma et al. (1996), Chaterjee and Misra (2001), Singh et al. (2002), Rahman et al. (2003) and Khalil et al. (2004). The higher estimate obtained from the sire component for BW20 and BW40 agrees with the report of Chaubal et al. (1994). The result from this study further corresponds with the report of Adeyinka (1998), Oni et al. (2000) and Nwagu (2004) for this strain. The higher heritability estimate obtained from the dam component than from sire, and sire plus dam component for egg weight could be attributed to maternal and/ or non additive gene effects. This result agrees with the findings of Bais et al. (1997). Similarly Oni et al (2000) had reported higher estimates for this strain in the first two years from the dam components. The heritability estimate was higher from the sire component for egg production up to 280 days when compared to those from dam and sire plus day component. Osborne (1953) was of the view that when heritability from sire component of variance is higher than the dam component, than sex linkage can be assumed. The higher estimate obtained from the sire component in this line for egg 280 days further corresponds with the findings of Oni et al. (2000).

The genetic and phenotypic correlations between the economic traits studied is presented in the Table 2. BW20 had moderate to high genetic and phenotypic relationship with BW40 and egg 280 days. The moderate to high positive correlation estimates obtained between BW20 and BW40 agreed with the general observation that body weight at all ages is highly heritable and are positively correlated (NIIR Board, 2004). The result of this study further corresponds with the report of Rahman et al. (2003). The negative genetic relationship observed between BW20 and egg weight could be due to low body weight which reflects poor growth of the egg forming reproductive traits which in turn would result in poor egg production and egg weight. The positive correlation observed between BW20 and egg production up to 280 days conforms with the reports of Sharmat et al. (1996) in the base generation. The results reveal that while BW40 and EWTAV and Egg 280 were positively correlated, negative genetic and phenotypic correlations were obtained between EWTAV and egg 280 days. The positive genetic and phenotypic correlations between BW40, EWTAV and egg 280 days indicate that pullets that attain higher body weight at 40 weeks would lay bigger sized eggs. Oni et al. (1992) had earlier reported positive phenotypic correlations between BW40

and EWTAV and also between EWTAV and Egg 280 days. The positive genetic correlation obtained between BW40 and egg 280 days further correspond with report of Adeyinka (1998) and Nwagu (2004). The negative genetic and phenotypic association obtained between egg weight average and egg production suggest that the relationship could become more antagonistic during the process of selection. The result obtained between egg weight and egg 280 days is in agreement with the reports of Sharma et al. (1996), Singh et al. (1992), Atkare and Khan (1998). This result also corresponds with findings of Oni et al. (1992 and 1994), Adeyinka (1998) and Nwagu (2004).

Table 1. Heritability estimates (± standard error) for traits of economic importance in the female line of layer type chickens.

Traits	Variance Components		
	h^2_s	h^2_d	h^2_{s+d}
BW20	0.78±0.15	0.16±0.11	0.25±0.05
BW40	0.23±0.08	0.11±0.10	0.17±0.05
EWTAV	0.42±0.10	0.66±0.11	0.54±0.06
Egg 280	0.62±0.16	0.25±0.11	0.35±0.05

h^2_S = Heritability from sire component
h^2_d = Heritability from dam component
h^2_{s+d} = Heritability from sire and dam components.

Table 2. Genetic and phenotypic correlations for traits of economic importance.

Traits	BW20	BW40	EWTAV	Egg 280
BW20	-	0.77	-0.10	0.51
BW40	0.28	-	0.12	0.68
EWTAV	0.35	0.23	-	-0.15
Egg 280	0.02	0.20	-0.09	-

Genetic correlations are above diagonal and phenotypic correlations are below diagonal.

References

Adeyinka, I. A. 1998. Short term response to selection in layer type chickens. Ph.D thesis submitted to the department of Animal Science, Ahmadu Bello University, Zaria Nigeria. pp.112.

Atkare, S. S and A. G. Khan. 1988. Relationship between part egg production records, body weight and egg weight-in IMW strain of White Leghorn breed. Ind. J. Anim. Sci. 58:361-365.

Bais, R. K. S., D. C. Johari, R. C. Hazary, M. C. Kataria, D. Sharma and R. D. Sharma. 1997. Inheritance of important economic traits in IWH strain of white Leghorn under reciprocal recurrent selection. Indian J. Poult. Sci. 32(2):189-191.

Becker, W. A. 1984. Manual of Procedures of Quantitative Genetics. Washington State University, Washington.

Chatterjee, R. N., B. S. Misra and H. N. Singh. 2000. Time trends in estimates of genetic parameters in a white Leghorn population subjected to long term selection. Indian. J. Anim. Sci. 70:184- 187.

Chatterjee, R. N. and B. S. Misra. 2001. Time trends of genetic parameters and realized phenotypic response in a white Leghorn population under long term selection. Indian Vet. J. 78:1112-1115

Chaubal, D. V., J. V. Solanki, R. K. Shukai, D. N. Rank, R. K. Mishra and K. Khama. 1994. Performance of white Leghorn pullets under reciprocal recurrent selection for two generation. Indian J. Poult. Sci. 29(3):211-217

Chaudhary, M. L., N. P. S. Bajwa, G. S. Brah and J. S. Sandhu. 1996. Variance component analysis of cross and purebred egg type chickens. Indian J. Poult. Sci. 31(1):18- 22.

Harvey, W. R. 1987. Users guide for LSMLMW and MIXEDL, PC-2 version. Mixed Model Least-Squares and Maximum Likelihood computer programme. Colombus, Ohio. pp. 91.

Harvey, W. R. 1990. Users guide for LSMLMW and MIXEDL, PC-2 version. Mixed model Least-Squars and Maximum likelihood Computer programme. Colombus, Ohio. pp. 91.

Khalil, M. K., A. H. Al-Homidan and H. I. Hermes. 2004. Crossbreeding components in age at first egg and egg production for crossing Saudi chickens with White Leghorn. Livestock Research for Rural Development. 16(1). pp. 10.

Laxmi, P. Jaya, Sree V. L. K Prasad, A. R. Murthy and R. C. Eswara. 2002. Correlations among various egg quality traits in White Leghorns. Indian Vet. J. 79:810-813.

NIIR Board. 2004. The complete technology book of dairy and poultry. Publ. National Institute of Industrial Research. Kamila Nagar, Delhi, India.

Nwagu, B. I. 2004. Estimation of genetic parameters using different methods in Rhode Island chickens selected for part-period egg production. Ph.D thesis submitted to the Dept. of Animal Science, Ahmadu Bello University, Zaria, Nigeria. pp. 103.

Oni, O. O., B. Y. Abubakar and F. D. Oyedepo. 1992. Inheritance of body weights and sexual dimorphism in two strains of Rhode Island chickens. A paper present at the 17th Annual Conference of the Nigerian Society for Animal Production Abuja-Nigeria. pp. 11.

Oni, O. O., B. Y. Abubakar, S. O. Ogundipe, I. A. Adeyinka and B. I. Nwagu. 1994. Age and body weight at sexual maturity in Rhode Island chickens. A paper presented at the 19th Annual Conference of the Nigerian Society for Animal production. Benin, Nigeria. pp. 6.

Oni, O. O., I. A. Adeyinka, B. Y. Abubakar, B. I. Nwagu, A. A. Sekoni and F. Abeke. 2000. Inheritance of economic traits in two strains of Rhode Island Chickens under selection. Trop. Agric. Trinidad. 77(2):67-69.

Osborne, R. 1953. The inheritance of egg weight in the domestic fowl. Further evidence of sex linkage. Poultry Science. 32:60-65

Osborne, R. 1957a. The use of sire and dam family averages in increasing the efficiency of selective breeding under hierarchical mating system. Heredity. 11:93-116.

Osborne, R. 1957b. Family selection in poultry. The use of sire and dam averages in choosing male parents. Proceeding Society Roy (Edinburgh). 64: 456-461.

Rahman, M., T. C. Roy and Bula Das. 2003. Genetic studies on some economic traits of White Leghorn chickens of Meghalaya. Indian Vet. J. 80:999-1001.

Sharma, A. K. and S. T. Krishna. 1998. Genetic and phenotypic parameters of economic traits in 'V' strain of White Leghorn under selection. Indian J. Poult. Sci. 33(2):198-201.

Sharma, D., D. C. Johari, M. C. Kataria, B. P. Singh, and R. C. Hazary. 1996. Effect of long term selection on genetic parameters of economic traits in White Leghorn. Asian, Australian J. of Anim. Sci. 9(4):455-459.

Singh, N. P., M. L. Chaudhary, G. S. Brah, and J. S. Sandhu. 1992. Evaluation of two White Leghorn strains and their reciprocal crosses for part year productivity. Indian J. of Poult. Sci. 27(3):139-143.

Singh, U. B., B. S. Chhikara, and K. L. Raheja. 2002b. Estimation of genetic parameters of various economic traits over different generation of selection in a closed population of White Leghorn. Indian J. Poult. Sci. 37(2):135-138.

Verma, S. K., P. K. Pani and S. C. Mohapatra. 1983. Genetic, phenotypic and environmental correlations among some of the economic traits in White Leghorn. Indian J. Anim. Sci. 53(10):1113-1117

Wei, M. and Vander Werf. 1995. Genetic correlation and heritabilities for purebred and crossbred performance in poultry egg production traits. J. Anim. Sci.73(8):2220-2226.