Asian Research Journal of Agriculture

7(2): 1-5, 2017; Article no.ARJA.38071
ISSN: 2456-561X

Genetic Parameters of Bodyweight and Egg Traits in the Domestic Pigeon

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Authors' contributions

This work was carried out in collaboration between all authors. Author SID designed the study, wrote the protocol, performed the statistical analysis and wrote the first draft of the manuscript. Author UAD managed the literature searches. Author DMO managed the analyses of the study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2017/38071
Editor(s):
(1) Sabri Gul, Professor, Depeartment of Animal Science, Mustafa Kemal University, Turkey.
(2) Jean Beguinot, Biogeosciences Department, University of Burgundy, France.
Reviewers:
(1) Senol Celik, Bingol University, Turkey.
(2) Ibrahim Şeker, Firat University Faculty of Veterinary Medicine, Turkey.
(3) Rafiqul Islam, Assam Agricultural University, India.
(4) Namita Brahma, Tata Institute of Social Sciences, Guwahati Campus, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/22250

Original Research Article

Received 9th November 2017
Accepted 7th December 2017
Published 11th December 2017

ABSTRACT

Seven hundred and twenty squabs raised from 180 couples of domestic pigeon were used to study the heritability, phenotypic and genetic correlations of body and egg traits. Body weight at hatch, 1- week, 2- weeks, 3- weeks, 4- weeks and at maturity were measured. Age at first egg and weight of first egg were the egg traits considered. The mean mature bodyweight, Age at first egg and weight of first egg were 416.39±1.77 g, 147.26±0.44 days and 18.06±0.10 g, respectively. Heritability estimates ranged from 0.24±0.03 to 0.57±0.07. Phenotypic and genetic correlations between bodyweights at different ages were positive and significant ($P<0.05$). It was concluded that the body and egg traits evaluated could be improved by mass selection method and any improvement in the bodyweight could lead to a concomitant increase in the associated trait.

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Keywords: Correlation; heritability; selection; squab.

1. INTRODUCTION

Domestic pigeon (*Colomba livia domestica*) are durable birds that can be raised with little capital input and they are able to survive in harsh climates. They are monogamous, couples are stable and prolificacy is low [1]. Farmed pigeons are promising as urban micro-livestock because they require little space, grow at a rapid rate, their meat is finely textured, has an attractive flavour and there are no taboos against consuming its meat or egg [2]. Despite all these numerous advantages, Nigeria still lay more emphasis on the production of poultry chicken. In order to improve the animal protein intake of Nigerians, there is need to diversity into domestic pigeon research to complement chicken production.

The performance of any population is a function of the genotype and the environment and the interaction between the two. Estimates of the genetic parameters are functions of the variances in that particular population at the time they were obtained [3]. The domestic pigeon is a reservoir of valuable animal genetic resources that have traditionally been used as a source of animal protein in Nigeria. There are no reliable estimates of pigeon population in Nigeria. The available population is largely genetically uncharacterized and unimproved. Information on the genetic parameters of economic traits of the pigeon are lacking or scanty in Taraba State, Nigeria.

This study was therefore undertaken to investigate the heritability, phenotypic and genetic correlations among some quantitative traits in the domestic pigeon with a view to assist in designing a breeding programme for improvement and sustainable use of pigeon genetic resources in Taraba State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Location

The study was conducted at a private poultry farm in Wukari Local Government Area of Taraba State. Wukari lies between latitude 7^0 51'N and longitude 9°47 'E [4]. It is located in the guinea savannah zone, North – East Nigeria in Taraba State. The mean annual rainfall is about 1300 mm. The mean annual maximum temperature varies from 30℃ to 39.4℃ while the mean annual minimum temperature ranges from 15℃ to 23℃ [5].

The foundation stock was made up of domestic pigeons purchased from rural farmers in Wukari, Donga and Takum Local Government Areas of Southern Taraba. They consisted of 180 couples (360 pigeons) maintained in the farm as unselected and unimproved paired-mating population to produce squabs for the study. Each pair of breeders was housed in a 40cm × 40cm × 25 cm wooden cage provided with a nest. They were Fed on a diet containing 15% crude protein and metabolizable energy (ME) of 2933 Kcal/Kg. Feed and water were supplied *ad-libitum*. The breeding pairs (couples) were allowed to mate lay eggs and incubate their eggs naturally to produce squabs. On hatching, squabs were weighed and identified by wing banding. Squabs were fed and nursed by their parents for four weeks after which they were fed the same breeders diet their parents feed on.

2.2 Measurement of Traits

Body weight at hatch, 1-week, 2-weeks, 3-weeks, 4-weeks and at maturity of each squab were recorded to the nearest gram using a sensitive digital electronic weighing scale.

The age (in days) of each pair of pigeon were recorded when the first egg was laid. The average of the records was considered the age at first egg.

When the first egg of each pigeon was laid, the weight in grammes was recorded. The average weight of all first eggs was considered the weight of first egg.

2.3 Statistical Analysis

Data generated were subjected to [6] statistical package to compute means (±standard errors), coefficient of variation and variance components using the variance component procedure (PROC VARCOMP). Heritabilities (h^2), Genetic and phenotypic correlations were estimated using formulae as described by [7]:

$$h^2 = \frac{2\delta_\alpha^2}{\delta_p^2}$$

Where δ_α^2 is the between mating variance component and δ_p^2 is the phenotypic variance.

$$r_{xy} = \frac{\text{cov (x,y)}}{\sqrt{var(x)var(y)}}$$

Where r_{xy} is the estimate of genetic or phenotypic correlation; cov (x, y) is the genetic or phenotypic covariance between traits *x* and *y*, and var *(x)* and *Var (y)* are the estimated genetic or phenotypic variance of traits *x* and *y*, respectively.

Standard errors *(SE)* of h^2 were estimated using the Formula as applied by [8]:

$$SE(h^2) = 2\sqrt{\frac{2(n-1)(1-t)^2\,(1+(K-1)t)^2)}{K^2\,(n-s)(s-1)}}$$

Where *n* is the total number of individuals; *t* is the interclass correlation; *k* is the coefficient of the between matings variance component and *s* is the number of matings.

3. RESULTS AND DISCUSSION

The mean body weights and egg traits of the domestic pigeon are shown in Table 1. The mean body weights significantly (P<0.05) increased from hatch to maturity as the pigeon progressed in age. The Age at first egg and weight of first egg were 147.26±0.44 days and 18.06±0.10 g, respectively. The body weight at hatch, 1,2,3,4 weeks of age and mature body weights were higher than those reported by [9]. The differences between the body weights at various ages might have arisen from variations in climatic and managerial conditions in which the pigeons were raised and to the possible differences in genetic make-up of the flocks. The mature bodyweight of 416.39±1.77 g reported in this study categorized the domestic pigeons in Taraba State as medium size breeds [10,11].

The age at first egg reported in this study is in close agreement with the value of 149.56±0.56 days reported by [9]. Age at first egg can be highly variable since it is affected by breed, nutrition and management practices. Early age of first egg could be an advantage because selection for it could lead to reduced generation interval. The 18.06±0.10 g obtained for weight of first egg in this study is slightly higher than the 16.88±0.13 g for egg weight reported by [9] but falls within the ranges of 16.77-22.82 g and 12-20 g reported by [12] and [13], respectively for the domestic pigeon.

The heritability estimates of some body and egg traits of the domestic pigeon are presented in Table 2. Heritability estimates of body weight ranged from 0.24±0.03 to 0.57±0.07.The heritability estimates of age at first egg and weight of first egg were 0.41±0.06 and 0.38±0.04, respectively. Heritability estimates for body weight at 1-week and 4-week of age were similar to the estimates reported by [7]. Heritability estimates of hatch weight (0.51±0.03) and mature body weight (0.44±0.09) corresponds to the findings of [9]. The heritabilities of age at first egg and weight of first egg reported in this study were lower than the values of 0.52 and 0.48 reported by [9].

The differences in heritability values could be as a result of different populations and methods of computation applied in the study. The moderate to high heritabilities with low standard error estimates of body and egg traits obtained in this study indicated that improvement in these traits could be rapid using mass selection procedures.

The genetic (r_G) and phenotypic (r_p) correlations between some body and egg traits in the domestic pigeon are displayed in Table 3. The genetic correlations among body traits ranged from 0.45 (for 1 week bodyweight × mature bodyweight) to 0.90 (for 3 week body weight ×4 week body weight). Phenotypic correlation for body traits ranged from 0.37 (for 1 week

Table 1. Means ± SE and coefficient of variation of some body and egg traits in the domestic pigeon

Traits	Mean ± SE	Coefficient of variation (%)
Hatch weight (g)	14.19±1.06	9.50
1 week bodyweight (g)	128.64±5.20	5.72
2 week bodyweight (g)	261.85±6.73	7.44
3 week bodyweight (g)	335.71±7.11	11.17
4 week bodyweight (g)	367.11±3.82	3.19
Mature bodyweight (g)	416.39±1.77	8.83
Age at 1st egg (days)	147.26±0.44	7.01
Weight of 1st egg (g)	18.06±0.10	4.26

Table 2. Heritability estimates of some body and egg traits in the domestic pigeon

Traits	h^2 (±SE)
Hatch weight	0.51±0.03
1 week bodyweight	0.24±0.03
2 week bodyweight	0.28±0.05
3 week bodyweight	0.33±0.08
4 week bodyweight	0.57±0.07
Mature bodyweight	0.44±0.09
Age at 1st egg	0.41±0.06
Weight of 1st egg	0.38±0.04

Table 3. Genetic (r_G) and phenotypic (r_P) correlations between some body and egg traits in the domestic pigeon

Traits	r_G	r_P
Hatch weight × 1 week bodyweight	0.70	0.61
Hatch weight × 2 week bodyweight	0.53	0.57
Hatch weight × 3 week bodyweight	0.88	0.43
Hatch weight × 4 week bodyweight	0.69	0.45
Hatch weight × Mature bodyweight	0.76	0.55
1 week bodyweight × 2 week bodyweight	0.89	0.78
1 week bodyweight × 3 week bodyweight	0.80	0.37
1 week bodyweight ×4 week bodyweight	0.71	0.49
1 week bodyweight ×Mature bodyweight	0.45	0.63
2 week bodyweight × 3 week bodyweight	0.80	0.66
2 week bodyweight × Mature bodyweight	0.48	0.59
3 week bodyweight × 4 week bodyweight	0.90	0.88
3 week bodyweight ×Mature bodyweight	0.53	0.68
4 week bodyweight × Mature bodyweight	0.61	0.77
Age at 1st egg × weight of 1st egg	0.65	0.12

Bodyweight × 3 week bodyweight) to 0.78 (for 1 week bodyweight × 2 week bodyweight). The genetic and phenotypic correlation between age at first egg and weight of first egg were 0.65 and 0.12, respectively.

The genetic and phenotypic correlation between 4-week body weight and mature body weight reported in this study is similar to the findings of [14]. Similarly, the genetic and phenotypic correlation between age of first egg and weight of first egg reported agrees with the findings of [15]. The strong and positive genetic relationships between bodyweights at different ages could be attributed to pleitropic and linkage effect of genes. This means that the same genes were controlling the bodyweight traits at different ages with increasing expressivity [16] expressed the same opinion in their work on the Japanese quail.

4. CONCLUSION

This study revealed that the domestic pigeon in Taraba State, Nigeria are medium size breeds which have their place in contributing to the genetic pool of our local animal genetic resources. Heritability estimates of body and egg traits were moderate to high. This suggests that the improvement in these traits by mass selection method would be effective. Improvement in any of the bodyweights could lead to a concomitant increase in the associated traits as a result of the strong and positive relationship between bodyweights at different ages.

ETHICAL APPROVAL

As per international standard or university standard, Ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/22250