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Genetic Parameters for Reproductive Traits in Indigenous Uttara Chickens

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ABSTRACT

The present study was carried out by utilizing 25 sires and 200 dams at the Instructional Poultry Farm (IPF), of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar from July 2014 to February 2016 using 3836 eggs using MMLSML computer programme. The purpose of this study was the estimation of genetic and phenotypic parameters of reproductive traits in indigenous Uttara chickens. The mean percentages for FERT, HFES, HTES, ASM and WSM were 70.09 ± 0.75, 68.80 ± 0.98, 49.71 ± 1.08 %, 171.24 ± 0.13 days and 1408.67 ± 0.92 g respectively. The small standard error for ASM indicated close uniformity in age at sexual maturity of the flock and is indicative of better managemental practices being followed at the farm. The highest heritability estimate (h^2) was 0.36 ± 0.02 for HTES. Genetic correlations for FERT with HFES (0.61 ± 0.03), HFES with HTES (0.92 ± 0.06) and FERT with HTES (0.86 ± 0.08) were positive and significant. Individuals with high breeding value for HTES would have high breeding values for HFES and FERT because of the high genetic association between them. These results suggest that HTES should be included as a selection criterion in genetic breeding programs to improve the reproductive performance of chickens, because HTES had the highest heritability estimate and high genetic correlation with FERT and HFES, and it is the easiest to measure.

Keywords: Fertility, hatchability, heritability, genetic correlation, sexual maturity age and weight

A native chicken population from Uttarakhand, named as "Uttara fowl" a distinctive bird with rich black plumage and feathered shank has recently been identified. This germplasm has a number of desirable characters such as hardiness, adaptability to the wide agro-climatic variability ranging from tropical and subtropical to alpine zones of India, disease tolerance, and flavor of meat and eggs (Singh *et al.,* 2016). The genetic reservoir of native hens establishes the basis for the breeding of birds in many developing countries. The breeding of indigenous hens for economic traits will result in an increase in the productivity levels of hens and will encourage traditional producers to choose indigenous hens. The estimates genetic parameters for reproductive traits in poultry can be useful for understanding and improvement of their genetic makeup.

MATERIALS AND METHODS

The present study was carried out by utilizing 25 sires and 200 dams at the Instructional Poultry Farm (IPF), of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar from July 2014 to February 2016 using 3836 eggs.

Statistical analysis

The least squares means of heritability estimates of traits under study were estimated from sire component of variances and covariances using MMLSML computer programme of Harvey (1990). Sex-wise genetic and phenotypic parameters of traits were estimated using the following statistical model after taking care of hatch effect in female reproduction traits:

$$Y_{ijk} = \mu + h_i + s_j + e_{ijk}$$

Y_{ijk} = observation on k^{th} progeny of j^{th} sire in i^{th} hatch,

μ = population mean,

h_i = fixed effect due to i^{th} hatch (i = 1, 2, ..H),

s_j = random effects due to j^{th} sire (j = 1,2,..S),

e_{ijk} = random error associated with each k^{th} observation with mean 0 and variance σ_e^2

RESULTS AND DISCUSSION

Least-squares means of reproduction traits

It is evident from the Table 1 that the mean fertility rate in Uttara fowl was 70.09±0.75 per cent. Similar rates of fertility were observed by Sharma (2009) in local hill fowl.

Table 1: Least-squares means of reproduction traits and their heritabilities in Uttara fowl

Sl. No.	Reproduction traits	Mean ± SE	h^2 ± S.E.
1	Fertility rate (%)	70.09 ± 0.75	0.14 ± 0.03
2	Hatchability on fertile egg set basis (%)	68.80 ± 0.98	0.32 ± 0.03
3	Hatchability on total egg set basis (%)	49.71 ± 1.01	0.36 ± 0.02
4	Age at sexual maturity (days)	171.24 ± 0.13	0.35 ± 0.04
5	Weight at sexual maturity (g)	1408.67 ± 0.92	0.87 ± 0.20

Lower fertility rates were observed by Pushkar (2013) in Uttara fowl comb and crown type. However, Faruque *et al.* (2010) in non-descript Deshi (ND) and Hilly (H) and Haunshi *et al.* (2012) in Aseel and Kadaknath observed higher fertility. These variations in fertility might be due to differences in genotypes and environmental conditions.

The hatchability on fertile egg set basis (HFES) in the present study was observed as 68.80±0.98 per cent with the corresponding hatchability on total egg set basis (HTES) as 49.71±1.01 per cent, which are again on the lower side. Hatchability being a typical fitness trait with a very low heritability cannot be improved by mere genetic selection and hence improvement in management of breeder hens and hatchery practices would therefore be the most promising route for obtaining desirable hatchability. Lower HFES were observed by Pushkar (2013) in Uttara fowl comb and crown type. Whereas, higher HFES observed by Faruque *et al.* (2010) in non-descript deshi (ND) and Hilly (H) and Haunshi *et al.* (2012) in Aseel and Kadaknath. These variations in HFES might be due to differences in management and environmental conditions at different locations.

Pushkar (2013) in Uttara fowl comb and crown type found lower HTES values than the present study whereas, Haunshi *et al.* (2012) in Aseel and Kadaknath and Magnesha (2012) in indigenous chicken observed higher HTES.

The age at sexual maturity in Uttara fowl was estimated to be 171.24±0.13 days as evident from Table 1. The average ASM is comparable with the reports of Hosseini and Tahmoorespur (2013) and Ansari (2015). However, present study average was lower than those reported by Haunshi *et al.* (2011), Singh *et al.* (2011) and Kumar *et al.* (2013). The small standard error for this trait indicated close uniformity in age at sexual maturity of the flock and is indicative of better managemental practices being followed at the farm. The variability in the present average and averages reported in the literature could be due to genetic and environmental differences in the different flocks. The low age at sexual maturity under study was the result of several cycles of selection for early maturity and higher egg production.

Similarly the average weight at sexual maturity (WSM) of Uttara fowls under study was computed to be 1408.67±0.92 g, which was comparable to one reported by Sharma *et al.* (2003) in control line. This average was higher than that reported by Faruque *et al.* (2013), Chatterjee (2013) and Regassa *et al.* (2013) but it was lower than that reported by Ghorbani *et al.* (2012), Padhi *et al.* (2015), Firozjah *et al.* (2015) and Salehinasab *et al.* (2015). Timely puberty in the experimental flock reflects better feeding and management of the flock during early growth period. The differences in WSM observed in the present study and could be due to genetic reasons and variation in the feeding and management of the flocks.

Heritability estimates of reproduction traits

Fertility

The heritability of fertility trait in Uttara fowl was estimated to be 0.14±0.03, which was in confirmatory with the reports of Savegnago *et al.* (2011). However, higher estimates of heritability were reported by Padhi *et al.* (2015). The heritability estimate of fertility trait indicated low genetic base.

Hatchability on fertile egg set basis (HFES)

The heritability of HFES in Uttara fowl was estimated as 0.32±0.03. Lower estimates of heritability were reported by Savegnago *et al.* (2011). However, a higher estimate of heritability was reported by Padhi *et al.* (2015). The moderate heritability estimates of HFES trait indicated sufficient genetic base for its genetic improvement.

Hatchability on total egg set basis (HTES)

The heritability of HTES in Uttara fowl was estimated to be 0.36±0.02. Savegnago *et al.* (2011) reported lower estimates of heritability. However, a higher estimate of heritability was reported by Padhi *et al.* (2015). Moderate heritability value for hatchability was indicative of the presence of additive genetic variation.

Age at sexual maturity (ASM)

The heritability of age at sexual maturity was estimated to be 0.35±0.04, which was comparable with the findings of Niknafs *et al.* (2012), Ghorbani *et al.* (2013), Hosseini and Tahmoorespur (2013) and Ebrahimzadeh-Allahabad *et al.* (2015) in Iranian native hen (Fars).

Lower estimates of heritability were reported by Rajkumar *et al.* (2012), Meshram *et al.* (2014) in IWP strain of WLH, Mishra *et al.* (2014) and Ebrahimzadeh-Allahabad *et al.* (2015) in Iranian native hen 'Khazak', 'Yazd', 'Mazandaran', 'Isfahan' and Padhi *et al.* (2015). However, a higher estimate of heritability was reported by Meshram *et al.* (2014) in IWN strain of WLH, Firozjah *et al.* (2015) and Padhi *et al.* (2015).

The higher magnitude of the heritability estimate of this trait could be due to the low environmental variation as a consequence of the highly standardized management by the breeding farm. The trait under study can be further improved by using selection, as sufficient additive genetic variance is still available to alter the ASM in Uttara flock.

Weight at sexual maturity (WSM)

The heritability of body weight at sexual maturity from sire component was 0.87±0.20. Padhi *et al.* (2015) were observed lower heritability estimates. However, higher estimates of heritability were reported by Niknafs *et al.* (2012), Ghorbani *et al.* (2012), Ghorbani *et al.* (2013), Firozjah *et al.* (2015), and Salehinasab *et al.* (2015). The higher magnitude of heritability estimate for this trait observed in present study indicated that this trait may be altered by individual selection.

Genetic and phenotypic correlations of reproduction traits

Table 2: Genetic (above diagonal) and phenotypic (below diagonal) correlations of fertility and hatchability traits[1]

	FERT	HFES	HTES
FERT		0.61±0.03	0.86±0.08
HFES	0.51±0.11		0.92±0.06
HTES	0.80±0.29	0.87±0.19	

[1]FERT = fertility; HFES = hatchability on fertile egg set basis; HTES = hatchability on total egg set basis.

The higher genetic correlations between hatchability (HTES and HFES) and fertility were 0.86±0.08 and 0.61±0.03 respectively (Table 2). Similarly genetic correlations between HFES and HTES were 0.92±0.06. The phenotypic correlations between HTES and HFES with FERT were 0.80±0.29 and 0.51±0.11 respectively. Similarly phenotypic correlations between HFES with HTES were 0.867±0.19. This result seems to suggest that both fertility and hatchability were positively correlated.

CONCLUSION

These results suggest that HTES should be included as a selection criterion in genetic breeding programs to improve the reproductive performance of chickens, because HTES had the highest heritability estimate and high genetic correlation with FERT and HFES, and it is the easiest to measure. Further research is needed to correlate reproductive traits with genetic markers, in order to improve chicken selection criterion in future.

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