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Genetic and non-genetic parameters of grower and layer performances in CARI-Sonali chicken#

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CARI-Sonali is a layer purpose brown egger chicken with wheaten/ golden white solid body plumage, dark red single comb and large wattle, yellowish skin, and yellow shank morphology. It was developed by mating males of IWH line of white Leghorn chicken with RIR female line at Central Avian Research Institute (CARI), Izatnagar. The layers are generally selected for optimum egg production with heavier egg size and good quality eggs, early sexual maturity and higher viability, and hence, it is desirable to have estimates of genetic and non-genetic parameters of these traits afresh in each population for each generation, because the estimates vary from one population to another and at different times (Barot *et al.* 2008). Therefore, the present investigation was carried out to evaluate genetic and non-genetic parameters of grower and layer performance traits in CARI-Sonali chicken.

The CARI-Sonali chicks (437) hatched out in 2 successive hatches (218 and 219 chicks) were investigated at the experimental layer farm of CARI, Izatnagar. The day-old chicks were wing-banded at the hatchery itself and subjected to standard litter brooding, housing and *ad lib.* feeding on the CARI-formulated feed provided with optimum management (Das *et al.* 2014a). The birds were vaccinated as per the standard vaccination schedule being followed at this institute (Das *et al.* 2014ab). The chick weight at day-old age and body weights at various weeks of age were measured in grams using digital weigh balance during morning at birds' empty stomach. The layer performances were assessed investigating the traits of housing weight at 20th week and body weight at 40th week of age, age at first egg (AFE), egg weights at 28th (EW28) and 40th (EW40) week of age and part period egg production (EP40) up to 40 weeks of age. The egg weights were taken in grams using the digital weigh balance (e: 5 mg) for successive 3 days and records were averaged to a single record. AFE was recorded in days as of laying her first egg and EP40 in numbers was calculated from the production data sheet. The data were analyzed by least squares analysis of variance (Harvey 1990) taking sex and hatch as fixed effects and chick weight and housing weight as regressors in the linear model.

The estimated least squares means along with various genetic and non-genetic factors of grower and layer performance traits in CARI-Sonali chicken ware presented in Tables 1 and 2, respectively. The present estimates represent CARI-Sonali as an elite chicken flock with better growth of body weights, age at first egg, egg weights and egg production as evident when compared to RIR chicken lines (Das 2013, Anonymous 2011)/ strains (Das *et al.* 2014b) and white Leghorn chicken strains (Jayalaxmi *et al.* 2010, Paleja *et al.* 2008). The better performances achieved in this present genotype were indicative of heterosis which might be due to combining ability of RIR females and IWH males of white Leghorn parents used to produce this crossbred chicken. Male birds had significantly ($P \leq 0.05$/ $P \leq 0.001$) heavier chick weights and body weights than the females throughout the ages (Table 1) indicating significant sex-differences (Das 2013) and counter role of sex, a genetic factor to control the growth of body mass. Significant sex-differences with more body weights in the males than the females were reported earlier (Das *et al.* 2016, Das *et al.* 2015a,b, Das *et al.* 2014a). Hatch is considered as a non-genetic factor and the present results indicated highly significant hatch-differences (Das 2013) for the estimates of chick weight, body weights (Tables 1, 2), age at first egg and egg production (Table 2) except the estimates of body weight at 16th week (Table 1) and housing weight at 20th week of age (Table 2). Significant hatch-differences were also reported earlier in white Leghorn (Shivakumar *et al.* 2011) and RIR chicken (Debnath *et al.* 2015, Nwagu *et al.* 2007).

The birds demonstrated significant regression effect of chick weight on the subsequent growth of the chicks

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Table 1. Estimated least squares means (LSM) along with different genetic and non-genetic factors of day-old chick weight and body weights at different ages in CARI-Sonali grower chicken

Factor	CW (g)	BW1 (g)	BW2 (g)	BW3 (g)	BW4 (g)	BW6 (g)	BW8 (g)	BW12 (g)	BW16 (g)
Population mean±SE	36.26±0.16 (437)	58.40±0.62 (210)	101.59±0.70 (423)	173.18±1.61 (206)	207.51±1.63 (412)	358.75±3.73 (206)	599.55±5.29 (305)	958.47±8.41 (399)	1446.31±22.96 (386)
Sex	*	ns	***	*	***	***	***	***	***
Male	36.63±0.22[a] (221)	58.73±0.87[a] (105)	104.34±0.99[a] (213)	176.89±2.29[a] (102)	218.26±2.31[a] (207)	379.13±5.31[a] (102)	628.49±7.25[a] (153)	1039.47±11.89[a] (201)	1636.37±32.06[a] (199)
Female	35.89±0.23[b] (216)	58.07±0.87[a] (105)	98.84±1.00[b] (210)	169.48±2.27[b] (104)	196.76±2.32[b] (205)	338.36±5.25[b] (104)	570.62±7.25[b] (152)	877.47±11.98[b] (198)	1256.25±33.08[b] (187)
Hatch	***	-	***	-	***	-	**	**	ns
Hatch-1	35.49±0.22[b] (218)	58.40±0.62 (210)	106.86±1.01[a] (209)	173.18±1.61 (206)	227.22±2.34[a] (206)	358.75±3.73 (206)	617.63±6.09[a] (206)	983.34±12.01[a] (201)	1466.40±32.79[a] (194)
Hatch-2	37.04±0.22[a] (219)	-	96.33±1.00[b] (214)	-	187.80±2.34[b] (206)	-	581.48±8.93[b] (99)	933.61±12.10[b] (198)	1426.21±32.96[a] (192)

CW, day-old chick weight in grams; BW, body weights in grams at different weeks of age; *P≤0.05, **P≤0.01, ***P≤0.001; ns, nonsignificant; means within a factor and same column having different superscripts differ significantly (P≤0.05); figures within parenthesis denote number of observations.

Table 2. Estimated least squares means (LSM) along with different genetic and non-genetic factors of various layer performance traits in CARI-Sonali chicken

Factors	BW20 (g)	AFE (days)	EW28 (g)	BW40 (g)	EW40 (g)	EP40 (nos.)
Population mean ± SE	1471.79±13.04 (183)	141.31±1.03 (183)	46.17±0.29 (176)	1626.66±12.24 (167)	52.87±0.29 (167)	107.78±1.72 (167)
Hatch	ns	***	ns	*	ns	*
Hatch-1	1465.69±18.98[a] (88)	146.66±1.49[b] (88)	46.29±0.42[a] (85)	1657.20±17.60[a] (81)	52.76±0.42[a] (81)	103.87±2.47[b] (81)
Hatch-2	1477.89±18.26[a] (95)	135.97±1.44[a] (95)	46.05±0.40[a] (91)	1596.13±17.08[b] (86)	52.97±0.41 (86)	111.68±2.40[a] (86)

BW, body weights in grams at different weeks of age; AFE, age at first egg in days; EW, weights (g) of the eggs laid at different weeks of age; EP40, part period egg production in numbers up to 40 weeks of age; *P≤0.05, ***P≤0.001; ns, nonsignificant; means within a factor and same column having different superscripts differ significantly (P≤0.05); figures within parenthesis denote number of observations.

Table 3. The estimated phenotypic correlations among various grower and layer performance traits in CARI-Sonali chicken

Grower traits	CW	BW1	BW2	BW3	BW4	BW6	BW8	BW12
BW1	0.080 (210)							
BW2	0.324 (423)	0.243 (206)						
BW3	0.364 (206)	0.209 (206)	0.767 (206)					
BW4	0.133 (412)	0.104 (206)	0.669 (412)	0.814 (206)				
BW6	0.311 (206)	0.115 (206)	0.451 (206)	0.558 (206)	0.676 (206)			
BW8	0.228 (305)	0.128 (206)	0.411 (305)	0.506 (206)	0.571 (305)	0.764 (206)		
BW12	0.199 (399)	0.132 (201)	0.403 (399)	0.437 (201)	0.479 (399)	0.609 (201)	0.671(275)	
BW16	0.193 (386)	0.038 (188)	0.172 (366)	0.095 (188)	0.195 (366)	0.227 (188)	0.271(275)	0.389 (366)

Layer performance traits	CW	BW20	AFE	EW28	BW40	EW40
BW20	0.272 (183)					
AFE	–0.217 (183)	–0.393 (183)				
EW28	–0.027 (176)	0.184 (176)	0.068 (176)			
BW40	0.212 (167)	0.562 (167)	–0.051 (167)	0.129 (167)		
EW40	0.246 (167)	0.200 (167)	0.101 (167)	0.424 (167)	0.274 (167)	
EP40	0.098 (167)	0.144 (167)	–0.380 (167)	–0.001 (167)	–0.087 (167)	–0.001 (167)

BW, body weights at different weeks of age; AFE, age at first egg; EW, weights of the eggs laid at different weeks of age; EP40, part period egg production up to 40 weeks of age; figures within parenthesis denote number of observations.

($P \leq 0.001$) for body weights of 2–12 weeks aged growers and housing weight of the pullets, whereas $P \leq 0.01$ for body weights of 16th week aged growers and 40th week aged pullets. The pullets also demonstrated significant regression effect of chick weight on its age at first egg ($P \leq 0.05$) and egg weight at 40th week of age ($P \leq 0.01$) (Das 2013). Similarly, the pullets also had significant regression effect of housing weight on its age at first egg ($P \leq 0.001$), body weight at 40th week of age ($P \leq 0.001$) and egg weights ($P \leq 0.05$) at 28th and 40th week of age (Das 2013). Thus results indicate that the future growth and layer performances of the birds could be judged better by the day-old chick weights and housing weights of the pullets.

The estimated phenotypic (r_P) correlation coefficients among various grower and layer performance traits ware presented in Table 3. The chick weight and different body weight traits were positively correlated with a range of 0.038 to 0.814 r_P coefficients. The chick weight had negative r_P with age at first egg and egg weight at 28th week of age, and positive r_P with other layer traits; though weights of the eggs laid at different ages could not demonstrate uniform direction of correlation. Housing weights (BW20) demonstrated positive r_P with chick weight and layer traits except age at first egg indicating early sexual maturity would favour heavy housing weight of the pullets on contrary to few reports (Anees *et al*. 2010, Choudhary *et al*. 2009). Age at first egg also demonstrated negative r_P with body weight at 40th week of age (contrary to Qadri *et al.* 2013) and egg production (Jayalaxmi *et al.* 2010, Ahmad and Singh 2007) indicating early sexual maturity would favour more egg production and heavy body weight at 40th week of age. Whereas, age at first egg had positive r_P with egg weights (Qadri *et al.* 2013, Barot *et al.* 2008) indicating selection for heavier egg size would delay sexual maturity. Egg production had positive r_P with chick weight and housing weight contrary to the reports in white Leghorn strains (Qadri *et al.* 2013). The negative r_P coefficients of egg production and egg weights traits were quite negligible. However, the present performance traits demonstrated a low to high range of phenotypic correlations though in variable directions, could be combined in a construct of standard selection indices and might be adopted in breeding strategy.

SUMMARY

CARI-Sonali day-old chicks (437) were investigated to estimate genetic and non-genetic parameters of its grower and layer performance traits. Sex and hatch-differences were significant in the least squares means of chick weight, body weights at different ages, age at first egg and egg production. The regression effects of chick weight and housing weight were significant for body weights, age at first egg and egg weights. The chick weight and housing weight had negative phenotypic correlation (r_P) with age at first egg and positive r_P with other layer traits. Age at first egg had positive r_P with egg weights and negative r_P with egg production. This information might be useful for adopting suitable breeding strategy.

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