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Factors Influencing Early Layer Economic Traits in Rhode Island Red Chicken

Jowel Debnath[1], Sanjeev Kumar[1*], S.K. Bhanja[2], Abdul Rahim[1] and Ramji Yadav[1]

[1]Division of Avian Genetics and Breeding, Central Avian Research Institute, Izatnagar, UP, INDIA
[2]Poultry Housing Management Section, Central Avian Research Institute, Izatnagar, UP, INDIA

**Corresponding author: skgcari@yahoo.co.uk*

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ABSTRACT

Rhode Island Red (RIR) chicken is a brown-egger chicken. At Central Avian Research Institute, it is being used to develop strains viz. selected (RIR^S) control (RIR^C) and white (RIR^W) for backyard poultry farming. Investigation was carried out to assess the influence of various factors on early layer economic traits in Rhode Island Red chicken. Two hundred eighty six straight run chicks were obtained from 11 sires and 44 dams in four hatches. Early layer production traits viz., chick weight (CW), body weights at 16 and 20 weeks of age (BW16 and BW20), age at first egg (AFE), egg weight at 28 weeks (EW28) and part period egg production up to 28 weeks of age (EP28)were recorded. Percent fertility and percent hatchability on total egg set and total egg transferred basis were 76.98, 61.44 and 79.85%, respectively. Least squares ANOVA revealed highly significant effect ($p \leq 0.01$) of hatch on BW20, EP28 and effect of sire on chick weight and significant effect of sire ($p \leq 0.05$) on BW16. The overall least squares means of CW, BW16, BW20, AFE, EW28 and EP28 were 34.50±0.47g, 1294.27±24.38g, 1562.32±25.65g, 136.79±1.52 days, 43.52± 0.76 g and 31.54±1.68 eggs, respectively. The pullets of first hatch revealed highest BW20 (1732.76±43.70 g) and EP28 (42.85±2.55 eggs). Present investigation revealed influence of sire and hatch on early layer economic traits and thereby suggested consideration of their role in planning breeding programmes for improvement of layers for economic traits in RIR.

Keywords: Chicken, hatch, layer traits, Rhode island red

In past few decades, poultry production in India has taken the shape of industry. Presently in India, layer industry is growing annually at the rate of 5 to 7% (Ponnuvel *et al.* 2014) and growth rate of broiler industry is 12% per annum (Gogoi and Mishra, 2013). It is primarily due to the increased demand for consumption of poultry egg and meat. Total poultry population in India is 729 million and the country ranks third in egg production and fifth in meat production (19th Livestock Census, 2012). Even then, the availability of egg is only 51 eggs per head per year which is much lower than the ICMR recommendation of 180 eggs per head per year (Borah and Halim, 2014). This gap may be filled up by improving genetic potential of birds through genetic selection. Part period egg production based selection has shown to genetically improve the annual egg production in various layer and broiler chicken and has brought about 85-90% change over last 50 years (Sharma and Chatterjee, 2006). The main emphasis of commercial breeders largely depends on layer economic traits like body weight, age and weight at sexual maturity, egg production and egg weight etc. Reports are available on

the influence of various non-genetic factors on layer economic traits viz., hatch (Mohammed *et al*. 2005, Nwague *et al*. 2007, Das *et al*. 2014b), sex (Das *et al*. 2014a, Das *et al*. 2014b, Das *et al*. 2015) etc. in chicken. Therefore, information on influence of various non-genetic factors like date of hatch, sex of the chick and the generation or year to which it belongs on these traits becomes prerequisite for formulating effective breeding strategies(*http://shodhganga.inflibnet.ac.in/bitstream/10603/6778/6/06_chapter%202.pdf*).

Rhode Island Red is a brown-egger dual purpose chicken breed (Rahim, 2015). It has been imported in this Institute almost 35 years ago and has undergone long-term selection for 30 generations on the basis of 40-week part-period egg production. The stock is being maintained at this institute as a close flock for development of multicolored strains for rural poultry production. Present investigation envisages assessing the early layer economic traits and influence of various factors on these traits in long-term selected RIR chicken.

MATERIALS AND METHODS

Experimental birds and genetic background

Two-hundred eighty-six chicks belonging to selected strain of RIR chicken, progeny of 11 sires, obtained in four hatches, first hatch on 4th Dec., 2014 an last hatch being on 5th January 2015,constituted the experimental birds. The parents belonged to 30th generation of selected strain of RIR chicken undergoing selection based on 40 week part-period egg production. The chicks were maintained at Experimental Layer Farm of Institute under standard management conditions from December 2014 to July 2015 and were used in this study.

Management and feeding

All the day-old chicks were initially vaccinated against F-strain of Newcastle disease, dubbed (beak trimming) to prevent fighting and wing-banded for pedigree recording at hatchery itself and brooded on the floor. At four weeks of age, chicks were transferred to litter grower house until 16 weeks of age. Afterwards, pullets were separated and shifted into laying cages for recording of individual egg production up to 28-weeks of age. Lighting, watering, feeding and vaccination programme of experimental birds were followed as per institute's schedule.

Fertility and hatchability

Percent fertility, hatchability on total egg set and hatchability on fertile eggs transferred were determined using standard statistical procedure.

Parameters recorded

Body weights (g) were recorded at 0-day (CW), 16(BW16) and 20 (BW20) weeks of age using digital weighing balance during morning hour before feeding. Egg weight (g) was recorded at 28 (EW28) weeks of age using digital weighing balance for three successive laying days and averaged to single record. Age at first egg (days) and part period egg production up to 28 weeks of age (EP28) (numbers) were individually recorded.

Statistical analysis

The data collected on body weight and early layer production traits were subjected to least squares analysis of variance using JMP 9.1 statistical program package (SAS, 2010) taking sire and hatch as fixed effects. The least squares means were compared by Critical Difference (CD) test (Stevens, 1999).

RESULTS AND DISCUSSION

Percent fertility and hatchability

Out of a total of 462 eggs collected, 358 fertile eggs were

Table 1. Least squares analysis of variance for early layer economic traits in Rhode Island Red chicken

Source of Variation	df	Mean sum of squares					
		CW	BW16	AFE	BW20	EW28	EP28
Hatch	3	21.92	81612.78	162.50	526946.3**	26.28	1611.23**
Sire	7	84.11**	123141.5*	252.68	103505.92	12.12	149.74
Error[1]	108	17.08	46252	155.20 (98)	51136(107)	15.34(38)	148.32(82)

CW - Chick weight, BW16 - Body weight at 16 weeks of age, AFE - Age at first egg, BW20 - Body weight at 20 weeks of age, EW28 - Egg weight at 28 weeks and EP28 -Egg production up to 28 weeks of age; df = degrees of freedom; *$P \leq 0.05$; ** $P \leq 0.01$; [1]Figure within parentheses are the error degrees of freedom.

transferred after candling on 18th day and 286 chicks were obtained in four hatches. The overall percent fertility was 76.98% and the percent hatchability on the basis of total eggs set and total eggs transferred were 61.44% and 79.85%, respectively. Miazi *et al*. (2012) reported that the fertility of eggs depends on various factors, such as: breed, season, lighting, level of nutrition and time of mating. In the present study, fertility (76.98 %) was lower than that reported by Malago and Batilwake (2009) as 91.1±4.42% and Das (2013) as 79.03% in selected strain of RIR chicken. Khan *et al*. (2014) reported overall percent hatchability and hatchability of fertile eggs were 51.41% and 65.69%, respectively, in RIR hens which were quite comparable to present findings. Jahan *et al*. (2015) reported percent hatchability of 86.7% in RIR chicken which was higher than the present finding. Rahim (2015) reported slightly lower fertility as 73.24% and hatchability on fertile eggs set and on total eggs set basis as 78.13% and 57.22%, respectively in RIR chicken than the present findings. The variations in different reports might be due to variation in the incubation and hatching conditions and genetic groups analyzed.

Early layer economic traits

Least squares analysis of variance revealed highly significant effect ($p \leq 0.01$) of hatch on body weight at 20 weeks and egg production at 28 weeks (EP28) and sire effect was significant on chick weight ($p \leq 0.01$)and body weight at 16 weeks (BW16)($p \leq 0.05$)(Table 1). Least squares means along with standard error of various early layer economic traits have been presented in Table 2. The overall least squares means of chick weight (CW), body weight at 16(BW16) and 20 (BW20) weeks, age at first egg (AFE), egg weight at 28 weeks (EW28) and part period egg production up to 28 weeks (EP28) were 34.50±0.47g, 1294.27±24.38 g, 1562.32±25.65 g, 136.79±1.52 days, 43.52±0.76 g and 31.54±1.68 eggs, respectively.

Jilani *et al.* (2005) reported that average AFE and BW20 were 146.16±0.33days and1395.68±5.05g in RIR chicken. Similarly, Saini *et al*. (2011) reported that average AFE and BW20 as 152±3.8days and 1369±20.7g and Khawaja *et al*. (2013) reported that the average AFE in RIR was 147±1.15 days in RIR chicken. Das (2013) reported that average CW, AFE, BW20 and EW28 were 37.55±0.24g, 150.81±0.93 days, 1596.58±11.67g and 44.84±0.21g, respectively. Present investigation revealed lower AFE and higher BW20 as compared to earlier reports, lower CW and EW28 and comparable BW20 than those reported by Das (2013). Present findings are

Table 2. Least squares means of early layer economic traits in Rhode Island Red chicken

Classes	N	CW(g)	BW16(g)	AFE(days)	BW20(g)	EW28(g)	EP28(eggs)
Overall	118	34.50±0.47	1294.27±24.38	136.79±1.52(108)	1562.32±25.65 (117)	43.52± 0.76(48)	31.54±1.68(92)
Hatches							
1	34	34.05±0.80	1360.63±41.53	133.57±2.43	1732.76±43.70^{a}	45.48±1.20(16)	42.85±2.55^{a}(32)
2	34	35.45±0.78	1281.62±40.83	138.53±2.49(32)	1613.56±42.95^{ab}	42.81±1.29(14)	28.35±2.72^{ab}(28)
3	20	33.45±0.95	1221.91±49.48	136.67±3.25(16)	1402.82±52.03^{b}	41.98±1.21(13)	30.42±3.41^{ab}(14)
4	31	35.04±0.80	1312.91±41.83	138.41±2.66(27)	1500.13±44.64^{ab}(30)	43.81±1.69(6)	24.54±2.98^{b} (19)
Sires							
1	14	33.57±1.13^{cd}	1375.40±58.63^{a}	132.10±3.40	1573.81±61.65	43.79±1.27 (11)	37.15±3.34
3	35	33.17±0.71^{cd}	1341.62±36.80^{ab}	140.53±2.21(33)	1594.50±38.70	44.10±1.09 (15)	30.17±2.48(26)
4	11	34.79±1.28^{bc}	1107.19±66.52^{c}	144.47± 4.86 (7)	1412.30±70.00	38.38±2.85 (2)	25.85±6.26 (4)
5	15	32.18±1.08^{cd}	1321.16±56.18^{ab}	132.15± 3.26	1532.86±59.09	44.11±1.76 (5)	30.77±3.40(13)
6	5	39.11±1.87^{a}	1181.87±97.09^{bc}	142.49± 6.28 (4)	1443.60±102.09	46.62±2.85 (2)	36.60±7.07 (3)
8	25	37.53±0.84^{ab}	1421.95±43.90^{a}	134.78± 2.69 (23)	1692.04±47.23(24)	42.71±1.34 (9)	28.82±2.77 (21)
9	9	31.05±1.38^{d}	1294.82±72.06^{abc}	134.03± 4.46 (8)	1585.78±75.78	42.93±2.35 (3)	26.05±4.37(8)
10	5	34.57±1.89^{bcd}	1310.13±98.49^{abc}	133.81± 5.72	1663.65±103.58	45.54±2.97(2)	36.90±6.26(4)

CW -Chick weight, BW16- Body weight at 16 weeks of age, AFE - Age at first egg, BW20- Body weight at 20 weeks of age, EW28- Egg weight at 28weeks and EP28-Egg production up to 28 weeks of age; N= Number of observations; Means bearing a different superscript in a column within a subclass differ significantly ($P \leq 0.05$)and figures within parentheses are the number of observations.

quite comparable with earlier report of Rahim (2015) in RIR chicken. The differences among various reports may be attributed to the variation in the genetic groups analyzed as well as to other prevailing non-genetic factors.

Influence of hatch on early layer economic traits

The least squares analysis of variance revealed that hatch effect was significant on BW20 and EP28 (Table 1). The pullets of first hatch revealed highest BW20 and EP28 with the estimates of 1732.76±43.70 g and 42.85±2.55 eggs, respectively. Although, the general managemental conditions were kept similar for all hatches, but probably variable micro-environment and sudden environmental fluctuations among hatches, beyond human control, might have resulted in significant hatch effect.

Similar to the present findings, Bohren *et al*. (1952) reported significant hatch effect on early egg weights. King and Henderson (1954) also reported that hatch effects were of considerable importance for egg production. Madapurada (2001) reported significant hatch effect on body weights at 20 weeks and age at sexual maturity in the colored broiler dam line, Punjab Broiler-II(PB2). Nwague *et al*. (2007) reported that hatch effect in RIR male (strain-A) and female (strain-B) lines might have contributed to the variable response in different economic traits, viz., ASM, EN280 days, BW40 and EW40 achieved in different generations. This might also be due to varying season of hatching across generations. Yahaya *et al*. (2009) also reported significant hatch effect on average egg weight at 40 weeks in pullets. Das (2013) reported significant hatch effect on CW, BW4, BW8, BW12, BW20 and AFE in selected strain of RIR chicken but in present finding hatch effect was significant on BW20 and EP28 only. The hatch differences may be assigned to the variable environmental conditions in different studies. Hatch effect masks the true genetic variation. Various factors may be involved to induce hatch effects such as the age and nutritional status of breeding individuals, time of hatching, the intervening periods between hatches, variations in egg size, sex ratio between hatches, brooder conditions, nutritional factors, grower stage management and the climatic factors to which breeding population were exposed to *(http://shodhganga.inflibnet.ac.in/bitstream/10603/6778/6/06_chapter%202.pdf)*. Hatch effects may be minimized by minimizing climatic and management variations like floor space, feeder space and feed together with uniform nutritional and vaccination programmes.

Influence of sire on early layer economic traits

The least squares analysis of variance revealed significant sire effect on CW and BW16. The pullets of sixth and eighth sire showed highest CW andBW16 with the estimates of 39.11±1.87 g and 1421.95±43.90 g, respectively. Sivaraman *et al.* (2005) had also reported significant sire effect on BW4, BW5 and BW6 in Synthetic Dam Line (SDL) broiler chicken. Das (2013) reported significant sire effect on CW, BW1, BW2, BW3, BW4, BW8, BW12 and BW20 in selected strain of RIR, which was comparable to the present findings. In breeding, sire is considered as half of the herd or flock, therefore selection of best sire is a prerequisite to execute proper breeding programmefor improvement of performance of a particular population.

CONCLUSION

Present investigation demonstrated significant effect of sire on chick weight and body weight at 16 weeks and that of hatch on body weight 20 weeks and egg production up to 28 weeks. Both, hatch and sire effects revealed significant role in layer economic traits of RIR chicken. It may be recommended that in order to optimally utilize the genetic resources and to design an effective breeding programme, hatch and sire effects should be optimized by providing uniform climatic and management conditions as far as possible and selecting the best sire, so that the optimum genetic progress and performance of population can be achieved.

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