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Effect of genotype and season on fertility and hatchability of eggs in Dahlem Red, Native and DND chicken under intensive system in Himachal Pradesh

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ABSTRACT

The present study assessed the effect of genotype, season and period on fertility and hatchability of chicken eggs during five year period (April 2017 to March 2022). The eggs for hatching were collected from birds belonging to three genotypes viz. Dahlem Red (DR), Native and cross of (Dahlem Red × Native) with Dahlem Red (DND). Average fertility percentage was observed highest in DND followed by native and Dahlem Red. Hatchability percentage on fertile egg set and total egg set was 80.91 & 70.20, 80.83 & 70.29 and 76.78 & 66.52 in native, DND and Dahlem Red respectively. Significant difference in hatchability percentage of Dahlem Red with native and DND was observed. Hatchability percentage was found better in native and DND bird. Season wise, fertility percentage was observed highest in winter (87.40) followed by rainy (86.34) and summer (86.01). Hatchability percentage on fertile egg set and total egg set was observed highest in rainy (81.22 & 70.09) followed by summer (80.60 & 69.36) and winter (77.31 & 67.63). Mean difference in hatchability on fertile egg set in winter was significant from rainy and summer season. Dead embryo percentage was observed significantly higher in winter than summer and rainy season. Hatchability percentage on fertile egg set and total egg set was highest in 2021-22 (83.73 & 76.54) followed by 2017-18 (80.91 & 69.48), 2018-19 (80.58 & 70.19), 2019-20 (76.76 & 66.08) and 2020-21 (76.38 & 65.93). The hatchability operations under sub temperate condition of the region can be carried out efficiently throughout the year without a significant drop in fertility and hatchability. However, greater care and managerial precision are required in winter season during the hatching.

Keywords: Fertility, Genotype, Hatchability, Season

Poultry production is gaining popularity in the developing countries because of its role in addressing protein deficiency and economic empowerment of the resource poor. Indian poultry industry has made remarkable progress evolving from small scale backyard venture to a commercial, full-fledged, self-sufficient and most progressive agro based industry (Verma *et al*. 2018). Fertility and hatchability are the two important factors which affect the profitability in the hatchery enterprise (Peters *et al*. 2008). Fertility and hatchability performance of eggs depend on the number of factors like genetic, physiological, social and environmental (Narahari *et al.* 1988). Fertility refers to the percentage of incubated eggs that are fertile while hatchability is the percentage of fertile eggs that hatch. Hatchability is a trait of economic importance in the chicken industry because it has a strong effect on chick output (Wolc *et al.* 2010). These are major parameters of reproductive performance which are most sensitive to genetic and environmental influence (Stomberg 1975). Heritability estimates for fertility and hatchability in chickens range from 0.06-0.13 (Sapp *et al*. 2004). This indicates that non-genetic factors have a higher influence on these traits. There are several reports indicating that genotype, age of breeder hen and season has significant effect on fertility and hatchability traits (Patra *et al.* 2016). However, there are limited information available on fertility and hatchability of Dahlem Red, Native and DND chicken. Therefore, the present investigation was carried out to study the effect of genotype, season and period on fertility and hatchability on fertile egg set and total egg set under intensive system of management in Himachal Pradesh.

MATERIALS AND METHODS

The study was conducted at University Poultry Farm, Palampur from April 2017 to March 2022. Birds were reared under deep litter system with standard feeding and management practices for a period of 72 weeks. Breeder hens maintained in the farm belongs to three genotypes viz. Dahlem Red (DR), Native (N), and cross of Dahlem Red × Native (DN) with Dahlem Red (DND, 75% DR inheritance). Each year was classified into three different seasons viz. summer (April to June), rainy (July to September) and winter (October– December). Hatchery

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operations remained suspended in January and February due to extreme cold climatic conditions in Palampur (H.P.). Eggs with proper shape and sound shell were selected while cracked, abnormal and odd coloured eggs were excluded. Eggs were properly cleaned and stored around 16ºC with 75% relative humidity for 7 days. Eggs were hatched by electric incubator having the capacity of 15000 eggs for setter and 5000 eggs for hatcher. The eggs were identified properly for different genotypes and were turned after one hour automatically by programmed device. The eggs were candled on 18th days of incubation to identify the fertile eggs; infertile eggs and eggs with dead embryos were removed. The fertile eggs were transferred from setter to hatcher on 18th day of incubation. On 21st day, hatched out chicks were collected and counted. Fertility percentage was calculated by number of fertile eggs divided by total number of eggs set while hatchability percentage on total egg set was calculated by the number of chicks hatched divided by total number of eggs set and multiplied by 100. The data on fertility and hatchability was analysed by using SPSS statistical package (version 20.0).

RESULTS AND DISCUSSION

Effect of genotype: The effects of genotype on fertility and hatchability of eggs is shown in Table 1. Highest fertility percentage was observed in DND (86.98) followed by native (86.72) and Dahlem Red (86.17). Effect of genotype on fertility was non-significant (P<0.05). Similar effect of genotype was observed on infertile egg percentage. Hatchability percentage on fertile egg set and total egg set was 80.91 & 70.20 in native, 80.83 & 70.29 in DND and 76.78 & 66.52 in Dahlem Red. There was significant difference (P<0.05) in hatchability percentage of Dahlem Red with native and DND. However no significant difference in hatchability percentage was observed between DND and native. Dead embryo percentage was significantly (P<0.05) higher in Dahlem Red than native and DND. Effect of genotype on chick weight was significant (P<0.05) and average chick weight was significantly higher in Dahlem Red (36.07) followed by DND (33.75) and native (31.60). The result of present study are consistent with earlier report of Islam *et al*. (2008) who observed significant effect of genotype on hatchability and highest hatchability was found in Fayoumi (78.34%) followed by WLH (76.48%) and RIR (74.59%) respectively. Contrary to present finding, Kalita *et al*. (2015) reported lower fertility percentage in PB2 × Indigenous (83.08) and indigenous chicken (77.50). However, Rajkumar *et al*. (2015) observed higher fertility percentage in Dahlem Red (92.90), Naked Neck (90.63) and PB-2 (79.34). Hatchability percentage on fertile egg set and total egg set were recorded as 91.50 & 79.87, 94.0 & 83.33 and 68.8 & 7.89 in Dahlem Red, Naked Neck and PB-2 respectively. In another study, Rajkumar *et al*. (2017) observed lower fertility percentage (67.18) and hatchability on total egg set basis (44.71) in wild Aseel chicken. The result of present findings are in agreement with earlier report of Verma *et al*. (2018) who revealed almost similar fertility percentage in Kadaknath (86.18) and Aseel (81.0) with significant difference among them. In a similar study, Rajkumar *et al*. (2020) reported that average fertility was 71.89% and hatchability on fertile egg set and total egg set was 80.52% and 57.08% in Grampriya female line chicken respectively.

Effect of season: Effect of season on fertility and hatchability traits is shown in Table 2. Among different season, fertility percentage was highest in winter (87.40) followed by rainy (86.34) and summer (86.01). However, difference was statistically non-significant. Higher fertility in winter season may be attributed to more favourable environmental condition for egg storage. Similar effect of season was obtained for infertile egg percentage. Hatchability percentage on fertile egg set and total egg set was observed highest in rainy (81.22 & 70.09) followed by summer (80.60 & 69.36) and winter (77.31 & 67.63), and mean difference in hatchability on fertile egg set was significant (P<0.05) in winter from rainy and summer season. However, hatchability percentage on total egg set did not differ significantly in summer, rainy and winter season. Lower hatchability in winter season may be attributed to the fact that during extreme winters, it was more difficult to maintain the hatcher and setter temperature continuously with precision compared to other seasons. Similarly, dead embryo percentage was observed significantly (P<0.05) higher in winter than summer and rainy season. Effect of season on chick weight was observed to be non-significant and average chick weight was obtained higher in rainy season. In contrast to present study, Islam *et al*. (2008) observed highest hatchability percentage in winter (78.62%) followed by monsoon (76.70%) and summer (75.79%) and the mean difference was significant (P<0.05). The

Table 1. Effect of genotype on fertility and hatchability (%) of eggs

	DR	Native	DND
Fertility	86.17±0.70[a]	86.72±0.82[a]	86.98±0.51[a]
Infertile eggs	13.80±0.70[a]	13.31±0.83[a]	12.99±0.51[a]
Hatchability on FES	76.78±1.62[a]	80.91±1.20[b]	80.83±1.09[b]
Hatchability on TES	66.52±1.62[a]	70.20±1.22[b]	70.29±1.09[b]
Dead embryo percentage	19.82±1.32[a]	16.43±1.01[b]	16.57±0.89[b]
Average chick weight	36.07±0.18[a]	31.60±0.33[b]	33.75±0.26[c]

Means bearing same superscript within rows do not differ significantly (P<0.05).

Table 2. Effect of season on fertility and hatchability (%) of eggs

	Summer	Rainy	Winter
Fertility	86.01±0.79[a]	86.34±0.44[a]	87.40±0.77[a]
Infertile eggs	13.98±0.79[a]	13.63±0.45[a]	12.62±0.79[a]
Hatchability on FES	80.60±1.19[a]	81.22±1.10[a]	77.31±1.38[b]
Hatchability on TES	69.36±1.33[a]	70.09±1.07[a]	67.63±1.66[a]
Dead embryo percentage	16.64±0.96[a]	16.20±0.64[a]	19.69±1.07[b]
Average chick weight	33.72±0.57[a]	34.2±0.46[a]	33.51±0.74[a]

Means bearing same superscript within rows do not differ significantly (P<0.05).

Table 3. Fertility and hatchability (%) estimate over the last 5 years

	2017-18	2018-19	2019-20	2020-21	2021-22
Fertility	85.80±0.37[a]	87.10±1.04[a]	86.17±0.67[a]	85.92±0.63[a]	87.83±1.15[a]
Infertile eggs	14.12±0.36[a]	12.89±1.05[a]	13.82±0.68[a]	14.11±0.67[a]	12.16±1.15[a]
Hatchability on FES	80.91±1.58[a]	80.58±0.95[a]	76.76±0.81[a]	76.38±2.39[a]	83.73±0.83[acd]
Hatchability on TES	69.48±1.44[a]	70.19±1.24[a]	66.08±1.13[a]	65.93±2.47[a]	76.54±1.61[acd]
Dead embryo percentage	16.38±0.36[a]	16.90±0.82[a]	19.99±0.60[a]	19.88±1.92[a]	14.33±0.87[acd]

Means bearing same superscript within rows do not differ significantly (P<0.05).

result of present study are consistent with earlier report of Kalita *et al*. (2012) who observed higher fertility and hatchability in summer season than spring season in Indigenous chicken of Assam and reported that percentage of dead in shell in the spring season was significantly higher than summer season. Sankhyan *et al*. (2015) also reported higher fertility percentage in winter season (90.54) followed by monsoon (86.74) and summer season (84.73). Similarly, Singh *et al*. (2018) reported higher hatchability on fertile egg set during spring (73.63%) followed by summer (71.58%) and was significantly (P<0.05) lower during winter (62.11%).

Effect of period: Effect of period on fertility and hatchability of egg is shown in Table 3. Fertility percentage was highest in 2021-22 and lowest in 2020-21. Fertility percentage did not differ significantly over the years. Similar result was noticed for infertile egg percentage where, infertile egg percentage was found higher in 2020-21 and lower in 2021-22. Hatchability percentage on fertile egg set and total egg set was highest in 2021-22 (83.73 &76.54) followed by 2017-18 (80.90 & 69.48), 2018-19 (80.58 & 70.19), 2019-20 (76.76 & 66.08) and 2020-21 (76.38 & 65.93). The mean difference in hatchability on TES and FES in 2021-22 differ significantly (P<0.05) from hatchability in 2019-20 and 2020-21. Similarly, dead embryo percentage in 2021-22 differed significantly from 2019-20 and 2020-21. However, dead embryo percentage in 2017-18, 2018-19 did not differ significantly from dead embryo percentage in 2019-20, 2020-21 and 2021-22.

The result of present investigation reported systematic investigation of various factor affecting the hatchability and fertility. The study revealed the significant effect of genotype on hatchability percentage, and hatchability on fertile egg set and total egg set was found to be higher in DND followed by native and Dahlem Red. Eggs from DND and native birds were found good for fertility and hatching purpose. The rainy and summer season was the best time for hatchability in the studied region of Himachal Pradesh. Moreover based on the demand received from various farmers over the years, summer and rainy season is most preferred season by farmers for chick delivery as chick brooding requirement are less intensive during this period.

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