



Factors affecting fertility, hatchability and chick survivability of Vanaraja birds under intensive rearing in sub-temperate condition

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ABSTRACT

The study was conducted to determine the effect of various factors viz. season, age of hen, egg weight and source of egg on reproductive performance of Vanaraja birds at an altitude of 1300 m at mean sea level in Sikkim. Fertility rate during summer was significantly higher than spring and winter. Fertility rate was significantly higher from 41 to 50 age of week as compared to 51 weeks onwards. Significantly higher fertility rate was observed in medium size egg as compared to other groups. The fertility rate of eggs produced in the farmers field were significantly lower than at farm. Hatchability on fertile egg set was highest during spring followed by summer while it was significantly lower during winter. Significantly higher hatchability was observed in age of 26 to 40 weeks compared to 51–60 and 61–70 weeks of age. Also, significantly higher hatchability was observed in medium size egg group than the other two groups. Chick weight on day of hatching was significantly higher in summer compared to autumn and winter. Egg weight also significantly affects chick weight which was highest in medium size egg. Significantly higher chick's survivability was recorded in summer, spring and autumn season as compared to winter. Although, season, age of hen, egg weight and source of egg affected the production performance of Vanaraja birds, but it can be reared successfully throughout the year for production purpose.

Key words: Fertility, Hatchability, Sikkim, Survivability, Vanaraja

Rearing local or indigenous breeds in backyard in Sikkim, one of the North - Eastern states situated in the Eastern Himalayan region, is a traditional activity of large number of rural households, the landless, small and marginal farmers of Sikkim Himalayas. It is a low input or no input venture that provides ready cash and food. Rural/backyard poultry farming with improved chicken varieties i.e. Vanaraja, Srinidhi and Gramapriya is slowly gaining popularity under ICAR-Poultry Seed Project as a potential tool to alleviate protein deficit and provides subsidiary income among the rural and tribal people across the country (Niranjan *et al.* 2008). Fertility and hatchability are the most important determinants for producing more chicks from given number of breeding stock within a stipulated period (Sankhyan *et al.* 2015). Fertility and hatchability performance of eggs depend on the number of factors like genetic, physiological, social and environmental (Narahari *et al.* 1988). There are several reports indicating that genotype, age of breeder hen and season has significant effect on fertility and hatchability traits (Elibol *et al.* 2002, Patra *et al.* 2016). However, there is no report available on

fertility and hatchability of Vanaraja birds at high altitude. Therefore, the present investigation was conducted to study the effect of season, age of hen, egg weight and source of egg on fertility, hatchability on fertile egg set and chick survivability in Sikkim Himalayan region.

MATERIALS AND METHODS

The study was conducted on Vanaraja chicken varieties maintained under Poultry Seed Project at ICAR Sikkim Centre at an altitude of 1,320 m amsl. The data presented here are of parent stock for a complete laying cycle from 26th week of age to 72nd week. Parent stock was maintained in deep litter system under intensive rearing with sex ratio of 1:8. Daily feeding and management was done as per the standard package of practices for the Vanaraja birds. Eggs of Vanaraja F1 line maintained under backyard rearing condition with supplementation of commercial feed were collected from farmer's field at one week interval for hatching purpose.

Eggs collection and storage: The eggs were collected daily morning and evening and graded, cleaned properly with mild disinfectant and stored at 15–18°C with relative humidity of 70–75% for seven days. Eggs were brought into room temperature one hour prior to incubation on 8th day. The eggs were then transferred to automated incubator and provided optimum temperature and humidity. Turning

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was done at one hour interval. Eggs were candled on 18th day for fertility and fertile eggs were then transferred to hatcher. For seeing the effect of egg weight on fertility and hatchability, eggs were graded in three groups according to their weights i.e. 45–50, 51–60 and 61–70 g from parent stock of age 52nd to 58th week. Season was classified as per Indian Meteorology Department i.e. spring from March to May, summer from June to August, autumn from September to November and winter from December to February.

Observations: Hatched out chicks (50 nos.) from each batch were weighed and recorded using digital electronic balances. The percent fertility and hatchability on fertile egg set were estimated using the formulae as below:

$$\text{Fertility (\%)} = \frac{\text{Number of fertile eggs}}{\text{Total no of eggs set}} \times 100$$

$$\text{Hatchability on fertile eggs set (\%)} = \frac{\text{No of eggs hatched out}}{\text{Total no of fertile eggs}} \times 100$$

$$\text{Chick survivability up to four weeks (\%)} = \frac{\text{Chicks survived up to four weeks}}{\text{Total chicks hatched out}} \times 100$$

Statistical analysis: Data generated for one laying cycle of Vanaraja parent stock were compared by one way ANOVA using SPSS statistical package. All data were presented as mean±SE. The difference of mean values for all data analysed with P<0.05 was considered as significant.

RESULTS AND DISCUSSION

The fertility rate (Table 1) varied from 84.56 to 90.47% during the different season of the year which is similar to optimum fertility potential of Vanaraja and other chicken

varieties (Asuquo and Okun 1993, Patra *et al.* 2016). Fertility rate during summer was significantly (P<0.05) higher than spring and winter. Lower fertility during winter might be due to harsh environmental condition particularly low temperature which forces the birds to conserve their energy to maintain the normal physiological function instead of more luxurious function like reproduction. Significant effect of season on fertility was also reported by Chowdhury *et al.* (2004) and Islam *et al.* (2008). Effect of age of hen was also seen on fertility rate and the fertility rate was significantly (P<0.05) higher from 41 to 50 age of week as compared to 51 to 60 and 61 to 72 weeks of age of hen. Hen age has influence on fertility of the eggs (Alsobayel 1992) and there is general tendency of fertility to decline with age (Insko *et al.* 1947). When fertility rate were compared on the basis of egg weight, significantly (P<0.05) higher fertility rate was observed in 51–60 g egg as compared to other groups. Maximum fertility was recorded in medium size eggs of Vanaraja and Gramapriya variety in Nagaland by Patra *et al.* (2016). Also, the fertility rate of eggs produced in the farmers field were significantly (P<0.05) lower than at farm. Birds were reared under semi-intensive condition at farmer's field with no supply of balance feed and proper deworming which may leads to lower fertility.

Hatchability on fertile egg set was highest during spring (73.63%) followed by summer (71.58%) while it was significantly (P<0.05) lower during winter (62.11%). Buragohain *et al.* (2005) reported lower hatchability (56%) in Vanaraja at higher altitude in Arunachal Pradesh which is very low compared to present study. Lower hatchability during winter may be attributed to the fact that during extreme winter there was much more difficulty to continuously maintain the hatcher and setter temperature

Table 1. Effect of season, age of hen, egg weight and source of egg on fertility, hatchability, chick weight and chick survivability in Vanaraja chicken (mean±SE)

| Attribute | Batches no. | Total eggs set | Fertility (%) | Hatchability on FES (%) | Chick weight (g) (n=50) | Chick survivability (%) (Up to 4 weeks) |
|---------------------------|-------------|----------------|--------------------------|-------------------------|-------------------------|---|
| <i>Season</i> | | | | | | |
| Spring | 12 | 18797 | 86.97±1.06 ^{bc} | 73.63±2.53 ^a | 37.72±0.64 ^a | 93.32±2.02 ^a |
| Summer | 12 | 17031 | 90.47±1.03 ^a | 71.58±4.31 ^a | 38.27±0.27 ^a | 96.24±2.56 ^a |
| Autumn | 12 | 15686 | 88.71±0.79 ^{ab} | 70.07±2.14 ^a | 34.01±0.83 ^b | 92.25±3.78 ^a |
| Winter | 12 | 10585 | 84.56±2.17 ^c | 62.11±3.52 ^b | 33.23±0.74 ^b | 83.31±2.98 ^b |
| <i>Age of hen (weeks)</i> | | | | | | |
| 26–40 | 14 | 15524 | 89.23±2.12 ^{ab} | 74.63±1.27 ^a | 34.23±1.01 ^a | 90.24±3.02 ^a |
| 41–50 | 10 | 19206 | 93.06±1.16 ^a | 72.97±2.01 ^a | 36.68±0.87 ^a | 94.17±2.16 ^a |
| 51–60 | 10 | 15245 | 87.05±2.12 ^b | 66.83±1.78 ^b | 36.45±0.89 ^a | 93.27±1.79 ^a |
| 61–72 | 12 | 12124 | 88.77±2.91 ^b | 67.74±2.08 ^b | 38.25±0.41 ^a | 92.21±2.14 ^a |
| <i>Egg weight (g)</i> | | | | | | |
| 45–50 | 4 | 728 | 78.26±2.45 ^c | 62.34±2.89 ^b | 31.25±2.56 ^b | 85.35±3.56 ^b |
| 51–60 | 4 | 907 | 93.86±1.23 ^a | 73.25±1.56 ^a | 36.54±0.59 ^a | 94.23±1.56 ^a |
| 61–70 | 4 | 619 | 87.36±2.36 ^b | 70.15±1.68 ^a | 38.89±0.91 ^a | 94.65±2.36 ^a |
| <i>Source of egg</i> | | | | | | |
| ICAR Farm | 14 | 22057 | 87.52±1.63 ^a | 67.85±2.12 ^a | 36.02±0.59 ^a | 94.56±2.45 ^a |
| Farmer's field (F1) | 14 | 4085 | 78.21±1.02 ^b | 61.25±2.10 ^b | 38.23±0.23 ^a | 95.01±2.72 ^a |

Means bearing different superscript in a column differ significantly (P<0.05).

with the precision capable in other season. Kingóri (2011) stated that exposure to the conditions that do not meet the needs of the developing embryo leads to lower hatchability. Highest hatchability was observed in age of 26th to 40th weeks (74.63%) followed by 41st to 50th week of age (72.97%) which further decreased significantly ($P < 0.05$) with advancement of hen age. The efficiency of reproduction decreases with age that is related to the internal egg composition, larger egg weight coupled with poor shell quality, increased early and late embryo mortality (Lesson and Summers 2000, Tona *et al.* 2004). Older breeder eggs tend to lose more weight in grams but less in percentage when compared to eggs from younger breeders. This is due to the associated increase in egg weight, as larger eggs have less shell area per unit of interior egg weight than smaller eggs (Nort and Bell 1990, Sankhya *et al.* 2015). When hatchability was compared for egg weight group basis, significantly ($P < 0.05$) higher hatchability was observed in 51–60 g egg weight group than the other 2 groups. Egg size affects hatchability due to the factors like nutrients quantity and quality besides having difference in surface area to volume ratio (Patra *et al.* 2016). Medium sized eggs of broiler parent line produced more hatching than small or large sized egg. Significantly ($P < 0.05$) higher hatchability was observed in eggs from farm compared to farmers field. This may be due to the fact that not all critical factors for ensuring balanced feed, proper collection and cleaning of eggs for hatching purpose were taken care at farmer's field compared to the farm condition. Patra *et al.* (2016) found higher hatchability in Vanaraja birds under farm condition in Nagaland. Heritability estimates for fertility and hatchability in chickens ranges from 0.06–0.13 (Sapp *et al.* 2014), this indicates that non-genetic factors have a higher influences on these traits.

Chick weight on day of hatching was significantly ($P < 0.05$) higher during summer and spring season as compared to autumn and winter. It is likely that the prenatal factors affecting incubation length, may also affect the individual in altered timing of ontogenetic processes and ability to cope with stress. Some studies also found physiological differences between early and late hatchers, such as different thyroid hormone levels and differences in organ weight and maturity (Van de Ven *et al.* 2011). There was no effect of age of hens and source of egg recorded on chick's weight at hatching. However, egg weight also significantly affected chick weight which was significantly ($P < 0.05$) higher in large and medium size eggs compared to smaller size eggs. Larger egg size correspond to more mass of the residual yolk sac that the chick retained. Effect of egg size on chick's weight was also reported significantly by Farooq *et al.* (2001) and Patra *et al.* (2016). Significantly ($P < 0.05$) higher chicks survivability was recorded in summer, spring and autumn season as compared to winter season. This may be attributed to extremely harsh environmental condition during the winter season. Sankhyan *et al.* (2015) also recorded the higher survivability of chicks during summer season. The difference in the rate

of chick survivability with respect to age of hen and source of collection was not significant among different groups. However, chick survivability was again significantly ($P < 0.05$) higher in large and medium size eggs compared to small size eggs. Large size eggs produced chicks of higher body weight at hatching which is a logical indicator of future growth performance and survivability.

It can be concluded from this study that fertility, hatchability and chick's survivability were affected by season of the year, hen's age, size of egg and source of egg. However, hatchability operation under Sikkim Himalayan condition can be effectively carried out throughout the year with slight reduction during winter season.

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