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Effect of egg quality traits on fertility and hatchability of Vanaraja parents

Smita Patil, VN Khune, MD Bobade, Sharad Mishra and Nishma Singh

Abstract
A study was undertaken to assess the effect of egg quality traits on the fertility and hatchability of Vanaraja Parents maintained in the poultry farm of the Poultry seed project of College of Veterinary Science and Animal Husbandry, Anjora, Durg (Chhattisgarh). A total of 150 numbers of eggs from each pen were selected for setting in a single-stage incubator for 48th, 49th, 52nd, and 55th week. Eggs were grouped and divided into three groups, i.e., below average, average, and above-average, according to their weight and shape index. Eggs were candled twice during incubation, i.e., on the 7th and 18th days. Fertility percent, hatchability percent on TES (total egg set basis), and FES (fertile egg set basis) calculated. The findings have shown that the highest fertility rate observed for average (53 – 61g) egg weight group were 90.12 %. However, significantly (P<0.01) highest overall hatchability on Fertile Egg Set (FES) basis was observed in the average group that is 89.22%. On the basis of their shape index, there is a significantly highest (P<0.01) fertility rate was observed in the average group that is 97.47%. The average hatchability on the Total Egg Set (TES) basis irrespective of different ages of the eggs of the average group (81.75%) was highly significant (P<0.01). And the average hatchability on the Fertile Egg Set (FES) basis irrespective of different ages of the eggs of average group 89.37% was highly significant (P<0.01). The results indicate that Vanaraja eggs having a normal oval shape and rounded shape hatch better as compared to the cylindrical eggs.

Keywords: egg weight, fertility, hatchability, shape index, Vanaraja

Introduction
Poultry production is the fastest-growing sector of Indian agriculture, having a long history of backyard farming. It has been transformed into a full-fledged industry to cope with the higher demands for valuable animal proteins (eggs and poultry meat) by an ever-increasing human population. The increased production is needed to be supplemented with an evaluation of the fertility and hatchability traits of the improved breeds suitable for backyard farming. Fertility and hatchability are two fundamental traits, and these traits are determined by many factors such as breed, age, egg qualities, storage time, and environmental conditions. As per the 20th livestock Census, 2019 p ;lionmil 851.81 oultry population in India isthe total poultry population has increased by 16.81 percent over the previous Census. The poultry sector in India has shown substantial improvement over the years. The total egg production reached 95.2 billion with per capita availability of 74 eggs per annum in 2018- 19, and the poultry meat production was estimated to be about 7.7 million tonnes for the same year. As far as egg consumption is concerned, it has been accepted worldwide as a staple food and included as an essential ingredient in a balanced human diet. The quality traits of an egg are those that affect its acceptability to the consumer. Hence, to maintain superiority in the overall quality of an egg, continuous genetic evaluation of different egg quality traits has become essential in today's production-oriented market. Vanaraja is a dual purpose; multi-coloured bird evolved at the Directorate on Poultry Research, Hyderabad, and is more suitable for backyard farming in Chhattisgarh, especially in the summer season. The Vanaraja male attained an average body weight of 1.57 kg at the age of 10 weeks, for the female, 1.12 kg. The average age at sexual maturity was 171 days, and the average egg production of 147 eggs /hen/annum with an average egg weight of 58 g. The percent of fertility and hatchability was 71.13 % and 72.6 %, respectively. Egg weight and shape index is an important economic trait along with egg production, which influences the egg quality as well as grading. It is the parameter that could be determined about the egg without breaking it. This investigation was carried out to estimate the effect of egg quality traits on fertility and hatchability in Vanaraja parent flock and to understand how egg weight, length, and width affect the size of chicks of Vanaraja.

Materials and Methods

The investigation was carried out at the Poultry farm of Vanaraja parents at Poultry Seed Project, College of Veterinary Science & Animal Husbandry, Anjora, Durg, during March and April 2016. In this study, a total of 270 Vanaraja breeder chickens (240 females, 30 males) were utilized. All chickens were of 48 weeks old at the start of the experiment and were reared under deep litter with standard management practices. Chickens were separated into three different pens (treatments – T_0, T_1, and T_2), each containing 78-79 females and 10-11 males to maintain an eight to one female to male ratio. Each pen was a 12 X 20 ft enclosure area in the Poultry farm of Vanaraja parents at Poultry Seed Project. Identification tags were applied to all the roosters in three rooms (pens). A total of 150 numbers of eggs from each pen were selected for setting in a single-stage incubator for 48th, 49th, 52nd, and 55th week. All the eggs were individually marked. Eggs were manually groups and divided into three groups, i.e., below average, average, and above average. Then eggs were transferred to an automated incubator for incubation. Eggs were candled twice during incubation, i.e., on the 7th and 18th days. Fertility percent, hatchability percent on TES (total egg set basis) and FES (fertile egg set basis) calculated by the formulae:

Fertility % = Number of fertile eggs / by total numbers of eggs set incubation X 100

Hatchability % (TES) = Number of egg hatched/ Total number of eggs set X 100

Hatchability % (FES) = Number of egg hatched / Fertile eggs set X 100

Statistical Analysis

Data were analyzed by the chi-square test, as suggested by Snedecor and Cochran (1994) [11], for the test of independence.

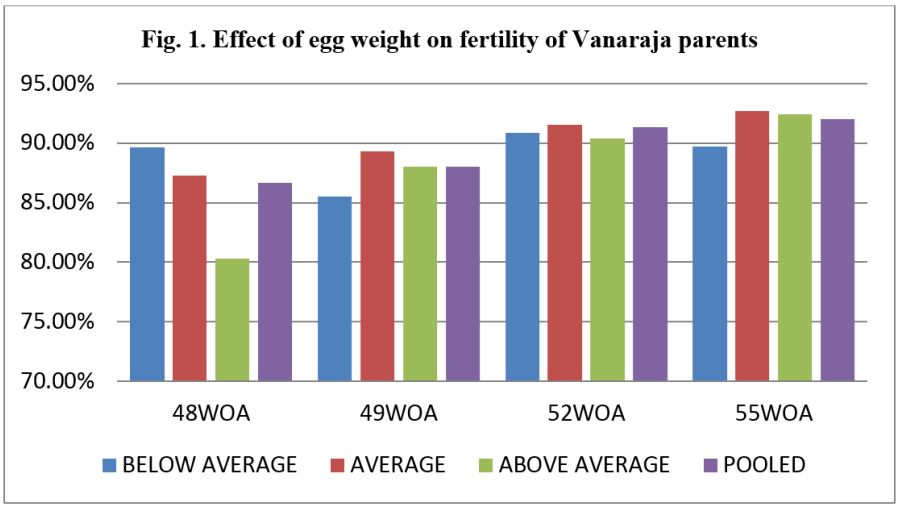
Results and Discussion

Effect of egg weight on the fertility and hatchability -The eggs from the Vanaraja parents were classified into three weight groups such as below average (46 – 53g), average (53 – 61g) and above-average (>61g) to study the effect of egg weight on the fertility and hatchability.

Table 1: Effect of egg weight on fertility and hatchability of Vanaraja parents

Week of age	Classes of egg weight	46-53gm (Below average)	53-61gm (Average)	>61gm (Above average)	Overall	x^2(chi-square)
48	No. of eggs	58	331	61	450	
	Fertility %	(52) 89.65	(289) 87.31	(49) 80.32	(390) 86.66	10.192**
	Hatchability (TES)	(44) 75.86	(254) 76.73	(41) 67.21	(339) 75.33	2.676 NS
	Hatchability (FES)	(44) 84.61	(254) 87.88	(41) 83.67	(339) 86.92	11.38**
49	No. of eggs	76	308	66	450	
	Fertility %	(65) 85.52	(275) 89.28	(56) 84.84	(396) 88.00	1.872 NS
	Hatchability (TES)	(57) 75.00	(240) 77.92	(50) 75.75	(347) 77.11	0.425 NS
	Hatchability (FES)	(57) 87.69	(240) 87.27	(50) 89.28	(347) 87.62	7.98**
52	No. of eggs	77	320	53	450	
	Fertility%	(70) 90.90	(293) 91.56	(47) 88.68	(410) 91.11	0.059 NS
	Hatchability (TES)	(60) 77.92	(265) 82.81	(41) 77.36	(366) 83.33	1.271 NS
	Hatchability (FES)	(60) 85.71	(265) 90.44	(41) 87.23	(366) 89.27	4.835 NS
55	No. of eggs	97	287	66	450	
	Fertility%	(87) 89.69	(266) 92.68	(61) 92.42	(414) 92.00	0.976 NS
	Hatchability (TES)	(77) 79.38	(243) 84.66	(53) 80.30	(373) 82.88	2.272 NS
	Hatchability (FES)	(77) 88.50	(243) 91.35	(53) 86.88	(373) 90.10	4.767 NS
Pooled	No. of eggs	308	1246	246	1800	
	Fertility%	(274) 88.96	(1123) 90.12	(213) 86.59	(1610) 89.44	2.329 NS
	Hatchability (TES)	(238) 77.27	(1002) 80.41	(185) 75.20	(1425) 79.17	3.838 NS
	Hatchability (FES)	(238) 86.86	(1002) 89.22	(185) 86.85	(1425) 88.51	25.186**

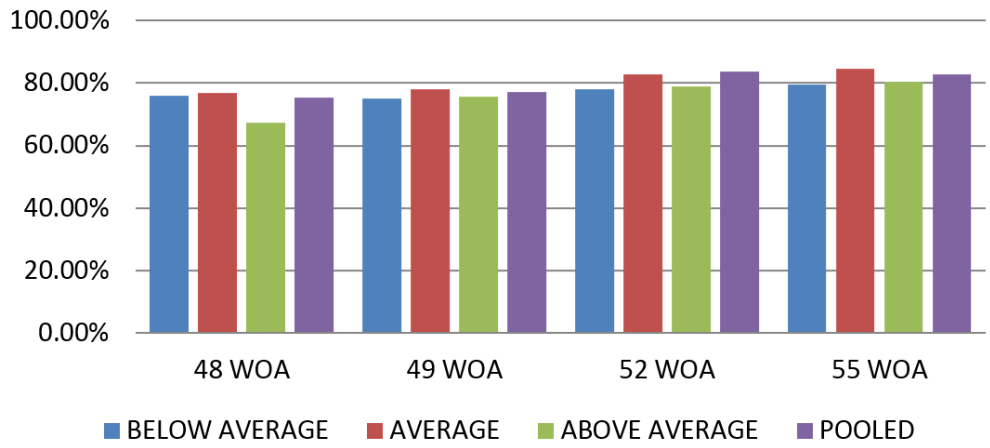
NS- Not Significant, **P<0.01 (values in the parenthesis are number of the eggs)



Fertility rates of egg weight groups -The observed pooled fertility rates for egg weight groups were 88.96, 90.12, and 86.93 percent in eggs of below average (46 – 53g), average (53 – 61g) and above-average (>61g) group, respectively (table1). In the present study, at 48 weeks of age, fertility rates of different egg weight groups differ significantly (P<0.01). The highest fertility rate was observed in eggs of the average group (90.12%). Workers like Khati *et al.* (1992, 2000) [7] and Ahmad *et al.* (2000) [1] observed an egg weight group has a significant effect on fertility (fig.1).

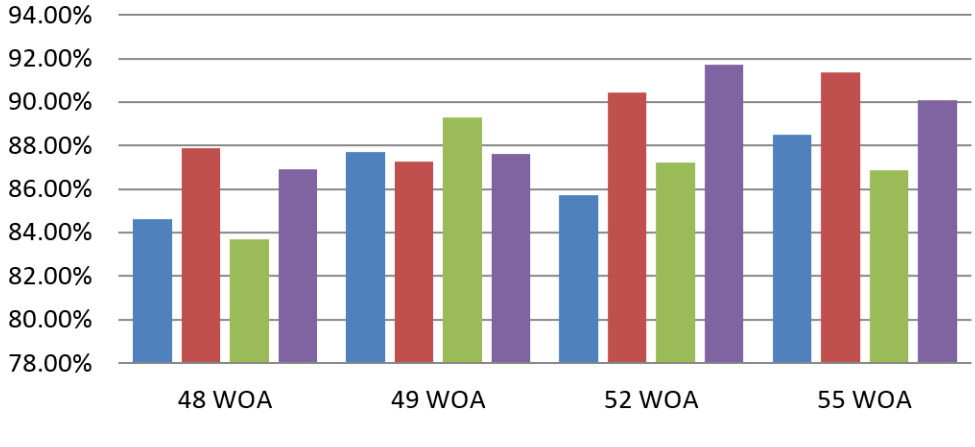
Hatchability rates on total egg set basis (TES) in egg weight groups –The pooled hatchability (TES) irrespective of different weeks of age was 77.27 percent for the below-average (46 – 53g) egg group, 80.41 percent for the average (53 – 61g) egg group and 75.51 percent for the above average (>61g) egg group (table 1). A higher value (P<0.01) for hatchability (TES) was observed in the middle group, indicating the suitability of medium-sized eggs for incubation (fig.2). This finding is in close agreement with earlier workers like Khati *et al.* (1992) [7].

Fig. 2. Effect of egg weight on hatchability (TES) of Vanaraja parents



Hatchability rates on total egg set basis (FES) in egg weight groups -Significantly (P<0.01) highest overall pooled hatchability (FES) irrespective of different weeks of age was observed in the average (53 – 61g) egg group (89.22%) than the below-average (46 – 53g) egg group (86.86%), and the above-average (>61g) egg group (86.85%) (table1). So, it was clear that the medium egg weight class was having better hatchability than a small and large egg weight class (fig.3). This finding was in agreement with the result obtained by several workers (Ahmad *et al.*, 2000) [1], who stated that average-sized eggs hatch better than very large and very small eggs. Veterany *et al.* (2000) [12] recorded better hatchability in medium-sized classes. The present study also supports the results obtained by Kang *et al.* (2002) [6].

Fig. 3. Effect of egg weight on hatchability (FES) of Vanaraja parents



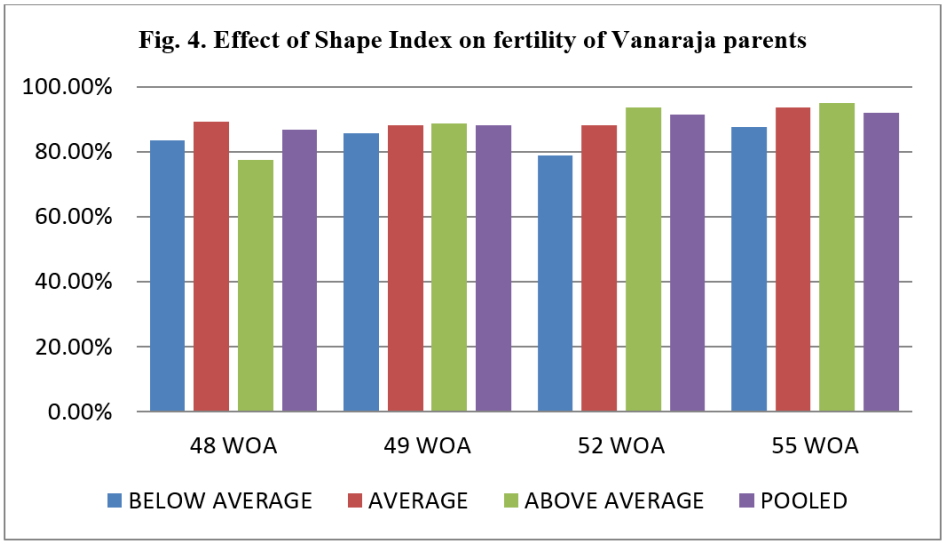
Effect of shape index of eggs on their fertility and hatchability: The length and width of all the eggs were measured with the help of a vernier caliper before setting for incubation. Eggs were classified as below average (55.5-63%), average (63-69%), and above-average (>69%).

Table 2: Effect of shape index on fertility and hatchability of Vanaraja parents

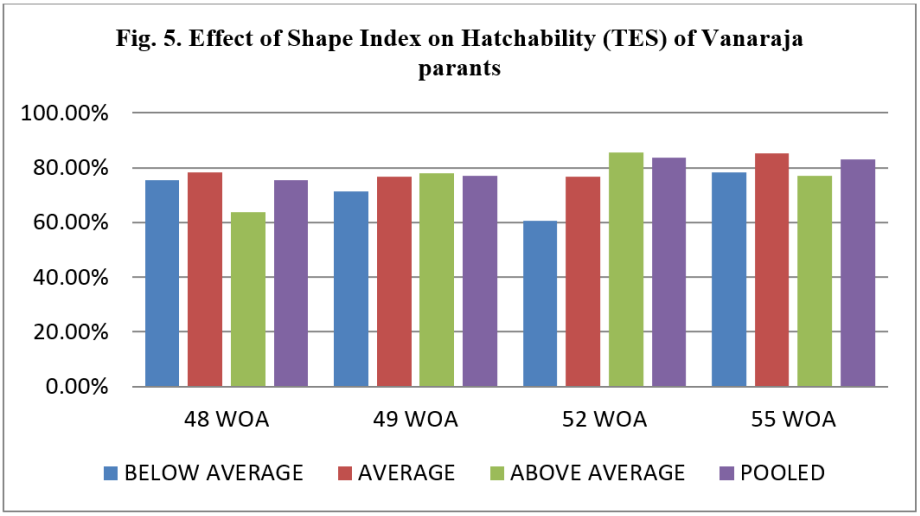
Week of age	Shape index classes	55.5-63% (Below average)	63-69% (Average)	>69% (Above average)	Overall	x^2(chi-square)
48	No. of eggs	36	334	80	450	
	Fertility %	30 (83.34)	298 (89.22)	62 (77.50)	390 (86.66)	8.112**
	Hatchability(TES)	27 (75.00)	261 (78.14)	51 (63.75)	339 (75.33)	7.186*
	Hatchability(FES)	27(90.00)	261 (87.58)	51 (82.25)	339 (86.92)	15.488**
49	No. of eggs	35	344	71	450	
	Fertility%	30 (85.71)	303 (88.08)	63 (88.73)	396 (88.00)	0.206 NS
	Hatchability (TES)	25 (71.42)	264 (76.74)	58 (81.69)	347 (77.11)	1.514 NS
	Hatchability(FES)	25 (83.33)	264 (87.12)	58 (92.06)	347 (87.62)	8.671**
52	No. of eggs	38	335	77	450	
	Fertility %	30 (78.94)	314 (93.73)	67 (87.01)	411 (91.33)	14.141**
	Hatchability (TES)	23 (60.5)	287 (85.67)	57 (74.02)	367 (81.56)	17.861**
	Hatchability(FES)	23 (76.66)	287 (91.40)	57 (85.07)	367 (89.29)	19.661**
55	No. of eggs	38	335	77	450	
	Fertility %	28 (73.68)	318 (94.93)	74 (96.10)	420 (93.33)	14.141**
	Hatchability(TES)	25 (65.79)	290 (86.57)	60 (77.92)	375 (83.33)	17.861**
	Hatchability(FES)	25 (89.28)	290 (91.19)	60 (81.08)	375 (89.29)	19.661**
Pooled	No. of eggs	147	1348	306	1801	
	Fertility %	118 (80.27)	1233 (91.47)	266 (86.92)	1617 (89.78)	11.157**
	Hatchability(TES)	100 (68.03)	1102 (81.75)	226 (73.85)	1428 (79.29)	15.239**
	Hatchability(FES)	100 (84.74)	1102 (89.37)	226 (84.96)	1428 (88.31)	22.456**

NS-Not Significant, *P<0.05, **P<0.01 (values in the parenthesis are in %)

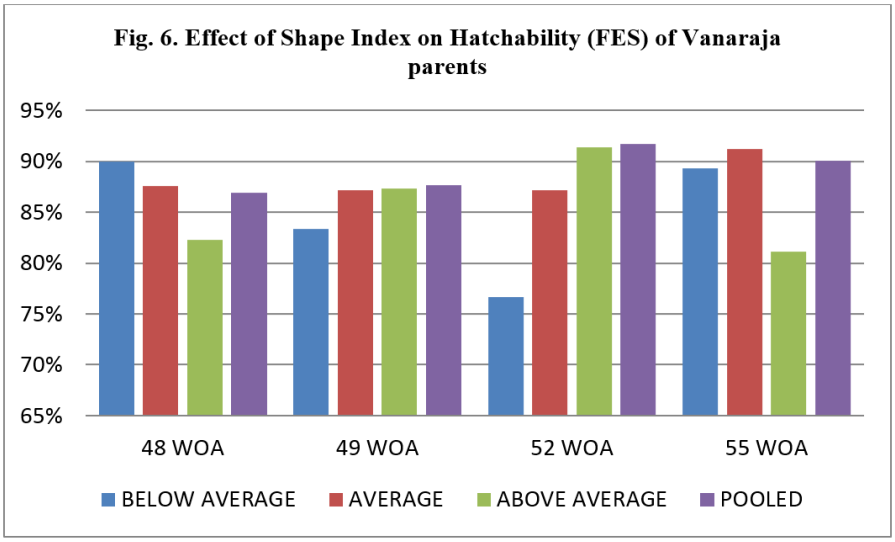
Fertility rates in shape index groups - The observed pooled fertility rates for egg shape index group were 80.27, 91.47, and 86.92 percent in eggs of below average (55.5-63%), average (63-69%) and above-average (>69%) group respectively (table2). In pooled data, significantly highest (P<0.01) fertility rate was observed in the average group, indicating that normal oval and slightly round-shaped eggs have higher fertility rates than those of cylindrical eggs (fig.4). Churchil *et al.* (2008) found no significant difference in the shape index classes in the White Leghorn breed. Ahmad *et al.* (2000) [1] found cylindrical eggs had slightly high fertile percentage than those of oval or roundish shaped eggs.



Hatchability rates on total egg set basis (TES) in shape index groups -The average hatchability (TES) irrespective of different weeks of age of the eggs of the average group (81.75%) was highly significant (P<0.01) than that of above average (73.85%) and the below-average group (68.03%) of shape index (table 2). These results indicate that Vanaraja eggs having a normal oval shape and slightly rounded shape hatch better as compared to the cylindrical eggs. Present findings were in agreement with the observation of early workers like Ahmad *et al.* (2000) [1]. However, a higher value for hatchability (TES) was observed in a mid group, indicating oval eggs had better hatchability (TES) than either cylindrical or round eggs (fig.5). The present finding is in agreement with the earlier findings of Sarda *et al.* (1978) [10] and Jay *et al.* (1985).



Hatchability rates on fertile egg set basis (FES) in shape index groups - The average hatchability (FES), in pooled data irrespective of different weeks of age, in the eggs of the average group (89.37%) was highly significant (P<0.01) than that of above average (84.96%) and of the below-average group (84.74%) of shape index (table 2). This indicates that the normal oval-shaped eggs have higher hatchability (FES) rates (fig. 6). The findings of this study were in close agreement with Churchil *et al.* (2008). However, results showed better hatchability (FES) in the mid group of shape index, which supported findings of Brar *et al.* (2002) [2]. On the contrary, Narushin and Romanov (2002) [9] found better hatchability in round-shaped eggs having a higher shape index.



Conclusion

Egg weight varies among the breeds, which have been studied by various workers. Egg weight and shape index influences the day-old chick weight, and higher body weight was observed from higher average egg weight. Higher fertility and hatchability rates were found in the average egg weight group. The chicks from cylindrical and oval eggs had good body weight compared with rounded eggs. In this investigation, it was clear that medium egg weight class having better hatchability than small and large egg weight classes. Average sized eggs hatch better than very large and very small eggs.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors Contribution

The research article is a part of the MVSc thesis submitted by the first author under the guidance of the next. Other authors have equally contributed to analyzing the experimental data.

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