International Journal of Poultry Science 1(4): 85-90, 2002

Comparative Assessment of Fertility and Hatchability of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock Hen

M. S. Islam[1], M. A. R. Howlider [2], F. Kabir[1] and J. Alam[1]
[1]Bangladesh Livestock Research Institute, Savar, Dhaka, Bangladesh
[2] Department of Poultry Science, Bangladesh Agricultural University, Mymensingh, Bangladesh

Abstract: A total of 3000 eggs; 750 eggs from each breed namely Barred Plymouth Rock (BPR),White Leghorn (WLH), Rhode Island Red (RIR) and White Rock (WR) were collected in 3 batches following AI from individually caged hens and were hatched to compare hatching parameters among breeds. The different hatchability traits of hen of different breeds; BPR, WLH, RIR and WR were compared. Hatching egg weight had no significant (P>0.05) difference among 4 genotypes. Fertility was highest in WLH, intermediate in WR and lowest and similar in BPR and RIR (P<0.01) with differences of fertility among 3 batches (P<0.01). Breed had little effect on hatchability of fertile eggs (P>0.05), but it differed among batches (P<0.01). Hatchability on total eggs was highest in WLH, intermediate in BPR and WR and lowest in RIR (P<0.05) and having also differences among batches (P<0.01). No significant (P>0.05) difference in dead in germs (DG) and dead in shell (DS) were found attributable to genotype, but DG and DS differed significantly(P<0.01) among 3 batches. Breed and batch had little effect on normal chicks and abnormal chicks hatched (P>0.05). Chick weight at hatching was highest (P<0.05) and similar in BPR (38.95 g) and WLH (38.96 g), intermediate in RIR (38.50 g) and lowest in WR (38.13 g). Batch had little effect on chick weight. Percent chick weight was found highest (P<0.01) in BPR (67.21%), intermediate in RIR (65.96%) and lowest and similar in WLH (65.17%) and WR (65.46%) without significant (P>0.05) difference in batches. There were some correlations among different hatchability traits depending on genotype within breed. The correlations were more profound among WLH. It was clear that chick weight as percent of egg weight was not just a function of egg weight, but also genotype played an important role favouring the heavier breeds.

Key Words: Fertility, hatchability, breed, cock, hen

Introduction

Poultry farming becoming popular in Bangladesh due to quick return, poverty alleviation and income generation. Profitable poultry farming mostly depends upon quality chicks and quality feeds. To fulfil the expanding demand production of quality chicks should be encouraged at a reasonable price in commercial hatcheries. There are many commercial poultry farm rear parent stock and practice natural mating. If reared in cages and they practice artificial insemination (AI) to reduce the number of breeder cock and thereby reduce their management cost. In AI, semen collected from one cock is used to inseminate 20-30 breeder hens against 1 cocks for 8-10 hens in natural mating. As a result the cost of producing baby chicks is also reduced and farmers can get quality sound chicks at a minimum cost. AI is specially needed when dwarf broiler dams are mated to normal cocks. But, limited informations are available on the influence of breed when cocks and hens are mated artificially. The degree of multiplication of any breeding stock is essential factor to determine success of poultry operations. Salahuddin *et al.* (1990) observed 80.79% egg fertility and 71.73% hatchability of fertile eggs for *deshi* chicken. Demming and Middelkoop (1999) recommended that hatchability in both types of broiler breeder was being determined by rates of infertility rather than early embryonic mortality. Increasing flock age was associated with increased infertility. Ali *et al.* (1993) hatched 517 eggs from Rhode Island Red (RIR), Fayoumi and RIR x Fayoumi fowls having egg weight of 61.2, 44.1 and 60.2 g respectively. Respective day old weights were 41.9, 30.2 and 40.2 g. Egg fertility and hatchability did not differ significantly among breed types. Fertility and hatchability are the most important determinant for producing more chicks from given number of breeding stock within a stipulated period. Fertility and hatchability performance of eggs depend on a number of factors like genetic, physiological, social and environmental (Warren, 1953; Olsen and Hyne, 1948; Hutt, 1938; Jull, 1970). The principal objective of the commercial hatchery is to secure the maximum number of quality day-old chicks out of the eggs set for hatching. The fertility and hatchability are interrelated heritable traits have variation among breed, varieties and individuals within breeds and varieties (Coony, 1943). Auxilia and Mastrorillo (1968) observed variation of hatchability of eggs among WLH, RIR and New Hampshire. But, environment and management (Jull, 1952; Jayarajan, 1992; Singh *et al.*, 1983; Warren, 1953; Hutt, 1949) often influence the effect of breed on egg fertility and hatchability. Little is known about comparative fertility and hatchability of different breeds of fowl under Bangladesh condition, specially when AI is practiced. With this idea in view, current experiment was studied to compare hatching performance of RIR, WR, WLH and BPR under Bangladesh condition using AI. The present experiment was designed:

1 to compare the fertility, hatchability and associated traits among RIR, WR, BPR and WLH
2 to find out the correlation among hatchability traits in different breeds.

Materials and Methods

The study was conducted at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh during the period of March to May, 2001. Four different breeds namely White Leghorn (WLH), White Rock (WR), Rhode Island Red (RIR) and Barred Plymouth Rock (BPR) were used in this experiment.

Birds management, incubation and experimental design: From each breed 50 hens and 10 cocks (200 breeder hen and 40 breeder cock) were selected randomly for this study. A total of 3000 hatching eggs (750 eggs per breed) were collected for incubation in 3 batches. The birds were individually caged in an open-sided house providing a cage space of 0.2 m^2 per bird and the cocks were trained for artificial semen collection. The birds were exposed to natural day light of 12 hours/day. All birds were

Table 1: Hatchability traits of Rhode Island Red (RIR), Barred Plymouth Rock (BPR), White Leghorn (WLH) and White Rock (WR) of dam

Parameter	Batch (BT)	Breed (B)					LSD (SED) and level of significance+		
		BPR	WLH	RIR	WR	Mean	B	BT	B X BT
Average egg weight (g)	1	57.61	57.98	58.33	58.34	58.07	(0.633) NS	(0.548) NS	(1.097) NS
	2	58.36	60.29	57.46	58.34	58.61			
	3	58.15	60.15	58.74	58.33	58.84			
	Mean	58.04	59.48	58.18	58.34	58.51			
Fertility (%)	1	84.63	93.97	89.50	90.40	89.63	5.597**	4.847**	(3.751)NS
	2	86.67	93.67	81.33	91.13	88.20			
	3	95.10	96.70	94.03	94.94	95.19			
	Mean	88.80	94.78	88.29	92.16	91.01			
Hatchability on fertile eggs(%)	1	86.53	87.23	83.27	91.53	87.14	(2.167) NS	4.849**	(3.753) NS
	2	83.30	87.77	83.50	90.40	86.24			
	3	95.93	95.45	98.33	93.86	95.89			
	Mean	88.59	90.15	88.37	91.93	89.76			
Hatchability on set eggs(%)	1	75.13	84.07	75.73	84.43	79.84	6.417*	5.557**	(4.301) NS
	2	76.77	81.87	70.60	81.13	77.59			
	3	91.93	92.30	92.37	88.99	91.40			
	Mean	81.28	86.08	79.57	84.85	82.94			
Dead in germ (%)	1	2.07	3.80	1.90	1.50	2.32	(1.066) NS	2.387**	(1.847) NS
	2	5.07	3.77	8.30	4.90	5.51			
	3	0.90	1.30	1.00	2.88	1.52			
	Mean	2.68	2.96	3.73	3.09	3.12			
Dead in shell(%)	1	7.20	6.30	9.70	4.97	7.04	(1.922) NS	3.102**	(2.401) NS
	2	5.63	8.37	3.67	6.60	6.07			
	3	2.00	3.93	2.17	3.66	2.94			
	Mean	4.94	6.20	5.18	5.08	5.35			
Normal chicks (%)	1	97.07	98.00	97.63	95.37	97.02	(0.981) NS	(0.850) NS	(1.699) NS
	2	97.70	98.93	98.70	96.40	97.93			
	3	98.43	96.77	99.33	97.70	98.06			
	Mean	97.73	97.90	98.56	96.49	97.67			
Abnormal chicks (%)	1	2.93	0.00	2.37	4.63	2.48	(0.860) NS	(0.745) NS	(1.490) NS
	2	2.30	1.07	1.30	3.60	2.07			
	3	1.57	3.23	0.67	2.20	1.94			
	Mean	2.27	1.43	1.44	3.51	2.16			
Average chick weight (g)	1	39.01	38.30	38.61	38.12	38.51	0.618*	(0.272) NS	(0.545) NS
	2	38.93	39.23	37.94	38.11	38.55			
	3	38.91	39.36	38.96	38.17	38.85			
	Mean	38.95	38.96	38.50	38.13	38.64			
Chick weight(%)	1	66.79	64.31	66.62	65.48	65.80	1.339**	(0.449) NS	(0.898) NS
	2	67.02	65.76	64.83	65.43	65.76			
	3	67.83	65.43	66.43	65.48	66.29			
	Mean	67.21	65.17	65.96	65.46	65.95			

+NS, P>0.05; *P<0.05; **P<0.01; All SED's are against 588 df.

fed *ad libitum* on diets containing 150 g crude protein, 11.3 MJ metabolizable energy (ME) and 10 g calcium per kg diet for cocks. The hens were fed on a breeder hen diet containing 180 g crude proteins, 11.3 MJ ME and 30 g calcium per kg diet. Semen from each cock was obtained twice a week in the later part of the day. Each hen was also inseminated twice a week throughout the experimental period. For each hen 0.05 ml undiluted semen was used for insemination each time. Hatching eggs were collected twice a day (8:00-11:00 and 14:00-17:00 h) and marked for individual cock and hen two days after first insemination. Good shaped and sound shell eggs were weighed and dipped in powerful disinfectant solution. Then eggs were stored over a period of one week in a cool room at 15 to 17 °C and 75 to 80% relative humidity (RH). Proper cleaning, disinfection and fumigation were conducted before setting of eggs. Eggs from a pullet were set adjacent to each other on the same tray. Number of eggs set for each individual sire-hen group of breed was recorded. The eggs were turned automatically programmed device 2 hourly. The following temperature and humidity was maintained during incubation period:

a) Setting temperature 99.7-100 °F up to 18 days of incubation.
b) Hatching temperature 1-2 °F reduced and 98.7 from 18 to 21 days of incubation.
c) Setting RH: 80-85% up to 18th day of incubation.
d) Hatching RH: 2-5% increased and 87-90% RH from 18 to 21 days of incubation and RH increased to 92% particularly at 21st day.

On the 10th and 18th day of incubation, the eggs were candled to identify and remove infertile or clean eggs and eggs with dead embryos (dead in germ) simultaneously. The remaining eggs were transferred from the setting trays to different pedigree compartment of hatching trays according to the breed and replication in the afternoon of the 18th day of incubation. On the day 21, the number of hatched chicks including the normal, weak, abnormal chicks and dead chicks after hatch and those the

Table 2: The correlation of different hatchability traits among hen of Barred Plymouth Rock (BPR)

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	0.063	1.000								
3	0.561**	-0.310**	1.000							
4	0.845**	-0.224**	0.811**	1.000						
5	0.006	-0.005	0.032	0.037	1.000					
6	0.064	-0.097	0.013	0.053	0.527**	1.000				
7	-0.004	-0.027	0.071	0.035	-0.307**	-0.380**	1.000			
8	0.040	0.087	0.073	0.022	-0.048	0.035	0.074	1.000		
9	-0.040	-0.087	-0.073	-0.022	0.048	-0.035	-0.074	-1.000**	1.000	
10	0.031	-0.093	-0.425**	-0.0347**	-0.048	0.101	-0.068	-0.033	0.033	1.000

Where, 1= Fertility (%), 2= Dead in germ (%), 3=Hatchability on fertile eggs (%), 4=Hatchability on set eggs (%), 5= Average egg weight (g), 6= Average chick weight (g), 7=Percent chick weight, 8= Normal chicks (%), 9=Abnormal chicks (%) and 10= Dead in shell (%).

Table 3: The correlation of different hatchability traits among hen of White Leghorn (WLH)

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	0.103	1.000								
3	0.289**	-0.524**	1.000							
4	0.638**	-0.412**	0.868**	1.000						
5	0.457**	0.062	0.288**	0.260**	1.000					
6	0.559**	0.066	0.341**	0.303**	0.881**	1.000				
7	0.597**	0.015	0.441**	0.381**	0.643**	0.828**	1.000			
8	0.481**	0.068	0.284**	0.248**	0.615**	0.742**	0.764**	1.000		
9	0.005	-0.076	0.102	0.081	-0.033	-0.023	0.037	-0.594	1.000	
10	-0.082	0.009	-0.678**	-0.622**	0.023	0.052	0.019	0.077	-0.072	1.000

Where, 1= Fertility (%), 2= Dead in germ (%), 3=Hatchability on fertile eggs (%), 4=Hatchability on set eggs (%), 5= Average egg weight (g), 6= Average chick weight (g), 7=Percent chick weight, 8= Normal chicks (%), 9=Abnormal chicks (%) and 10= Dead in shell (%).

unhatched eggs and pips were counted separately as dead in shell according to breeds and replication were recorded. The chicks, which were undersized, poorly feathered, parrot beaked, micromelia, blind, lameness, open naveled etc. were considered as abnormal chicks. After discarding all abnormal chicks the rest of the chicks were considered as normal. The weight of all hatching eggs was taken in gram by using an electronic digital balance. Then average was calculated. Calculation were made of fertility, hatchability, embryonic mortality, dead in germ, dead in shell, abnormal chicks hatched, normal chicks hatched. The weight of day-old chicks was taken in gram by using an electronic digital balance and then average was calculated. Hatchery sanitation was strictly maintained during the experimental period.

Statistical analysis: All the data were analyzed for ANOVA using a Completely Randomized Design (CRD) with the help of a computer package programme SPSS. Significant differences to compare mean values of all parameters among the treatments were found out using Least Significant Differences (LSD).

The following model was used during data analysis:

$Y_{ijk} = F + B_i + b_j + (B \text{ õ } b)_{I} + e_{ijk}$

Where:

Y_{ijk} is the observation of the kth population of ith breed and jth batches.

F is the overall mean

B_i is the fixed effect of ith breed (I = 1,2,3,4)

b_j is the fixed effect of jth batch (j = 1,2,3)

e_{ijk} is the random error assumed to be distributed $(0,\text{ó}^2)$

Results

Effect of hen of different breeds on hatchability traits: The different hatchability traits as influenced by hens of different breeds; Barred Plymouth Rock (BPR), White Leghorn (WLH), Rhode Island Red (RIR) and White Rock (WR) are presented in Table 1. Among 4 genotypes, hatching egg weight had no significant (P>0.05) difference. Apparently, eggs were largest for WLH (59.48%) followed by those of WR (58.34%), RIR (58.18%) and BPR (58.04%) without significant (P>0.05) difference among batches. Fertility was highest in WLH, intermediate in WR and lowest and similar in BPR and RIR (P<0.01) with also differences of fertility among 3 batches (P<0.01). Breed had little effect on hatchability on fertile eggs (P>0.05) having differences among 3 batches. However, hatchability on total eggs was highest in WLH, intermediate in BPR and WR and lowest in RIR (P<0.05) and having also differences among batches (P<0.01). No significant difference in dead in germs (DG) was found attributable to genotype, but DG differed among 3 batches of hatch. The percentage of dead in shell (DS) did not differ significantly (P>0.05) among breeds. Apparently, DS observed was highest in WLH (6.20%) followed by those of RIR (5.98%), WR (5.08%) and BPR (4.94%). However, DS differed significantly among 3 batches (P<0.01). The percentage of normal chicks hatched was slightly highest in RIR (98.56%) followed by those of WLH (97.70%), BPR (97.73%) and WR (96.49%) with no significant difference among the breeds and batches. Breed and batch had little effect on abnormal chicks hatched (P>0.05). Among the breeds, WR had highest (3.51%) abnormal chicks followed by those of BPR (2.27%), RIR (1.44%) and WLH (1.43%). Chick weight at hatching was highest (P<0.05) and similar in BPR (38.95 g) and WLH (38.96 g), intermediate in RIR (38.50 g) and lowest in WR (38.13 g). Batch had little effect on chick weight. Chick weight as percent of egg weight was found highest (P<0.01) in BPR (67.21%), intermediate in RIR (65.96%) and lowest and similar in WLH (65.17%) and WR (65.46%). Batch had no significant influence on percent chick weight (P >0.05).

Correlation of hatchability traits for hen: Correlation among hatchability traits of 4 genotypes are presented in Table 2-5.

Table 4: The correlation of different hatchability traits among hen of Rhode Island Red (RIR)

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	0.121	1.000								
3	0.230**	-0.376**	1.000							
4	0.699**	-0.213**	0.744**	1.000						
5	0.346**	0.045	0.334**	0.286**	1.000					
6	0.376**	0.040	0.332**	0.310**	0.918**	1.000				
7	0.302**	0.032	0.249**	0.240**	0.529**	0.774**	1.000			
8	0.207*	0.042	0.101	0.146	-0.023	0.003	-0.023	1.000		
9	-0.207*	-0.042	-0.101	-0.146	0.023	-0.003	0.023	-1.000**	1.000	
10	0.086	-0.091	-0.344**	-0.270**	0.061	0.051	0.006	0.024	-0.024	1.000

Where, 1= Fertility (%), 2= Dead in germ (%), 3=Hatchability on fertile eggs (%), 4=Hatchability on set eggs (%), 5= Average egg weight (g), 6= Average chick weight (g), 7=Percent chick weight, 8= Normal chicks (%), 9=Abnormal chicks (%) and 10= Dead in shell (%).

Table 5: The correlation of different hatchability traits among hen of White Rock (WR)

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	-0.106	1.000								
3	0.257**	-0.432**	1.000							
4	0.811**	-0.411**	0.674**	1.000						
5	0.063	-0.026	0.065	0.052	1.000					
6	0.109	-0.023	0.129	0.131	0.909**	1.000				
7	-0.021	-0.002	0.003	0.018	-0.947**	-0.742**	1.000			
8	-0.012	0.010	-0.025	-0.005	-0.118	-0.077	0.124	1.000		
9	0.012	-0.010	0.025	0.005	0.118	0.077	-0.124	-1.000**	1.000	
10	0.058	-0.066	-0.608**	-0.387**	0.033	-0.048	-0.078	-0.073	0.073	1.000

Where, 1= Fertility (%), 2= Dead in germ (%), 3=Hatchability on fertile eggs (%), 4=Hatchability on set eggs (%), 5= Average egg weight (g), 6= Average chick weight (g), 7=Percent chick weight, 8= Normal chicks (%), 9=Abnormal chicks (%) and 10= Dead in shell (%).

Barred Plymouth Rock (BPR) : Significant positive correlation was found between fertility and hatchability on fertile eggs (P<0.01)), fertility and hatchability on set eggs (P<0.01), egg weight and chick weight (P<0.01) and hatchability on fertile eggs and hatchability on set eggs (P<0.01). Some significant negative correlation was observed between dead in germ and hatchability on fertile eggs (P<0.01), dead in germ and hatchability on set eggs (P<0.01), hatchability on fertile eggs and dead in shell (P<0.01), hatchability in set eggs and dead in shell (P<0.01), egg weight and percent chick weight (P<0.01), chick weight and percent chick weight (P<0.01) and normal chicks and abnormal chicks (P<0.01).

White Leghorn (WLH): Significant positive correlations were found between fertility and hatchability on fertile eggs (P<0.01), fertility and hatchability on set eggs (P<0.01), egg weight and fertility (P<0.01), fertility and chick weight (P<0.01), fertility and percent chick weight (P<0.01), fertility and normal chicks (P<0.01), hatchability on fertile eggs and hatchability on set eggs (P<.01), egg weight and hatchability on fertile eggs (P<0.01), hatchability on fertile eggs and chick weight (P<0.01), hatchability on fertile eggs and percent chick weight (P<0.01), hatchability on fertile eggs and normal chicks (P<0.01), hatchability in set eggs and egg weight (P<0.01), hatchability on set eggs and chick weight (P<0.01), hatchability on set eggs and percent chick weight (P<0.01), hatchability on set eggs and normal chicks (P<0.01), egg weight and chick weight (P<0.01), egg weight and percent chick weight (P<0.01), egg weight and normal chick (P<.01), chick weight and percent chick weight (P<0.01),chick weight and normal chick (P<0.01) and percent chick weight and normal chick (P<0.01). Significant negative correlations were observed between dead in germ and hatchability on fertile eggs (P<0.01), dead in germ and hatchability on set eggs (P<0.01), hatchability on fertile eggs and dead in shell (P<0.01) and hatchability in set eggs and dead in shell (P<0.01).

Rhode Island Red (RIR) : Significant positive correlation were found between fertility and hatchability on fertile eggs (P<0.01), fertility and hatchability on set eggs (P<0.01), egg weight and fertility (P<0.01), fertility and chick weight (P<0.01), fertility and percent chick weight (P<0.01), hatchability on fertile eggs and hatchability on set eggs (P<0.01), egg weight and hatchability on fertile eggs (P<0.01), hatchability on fertile eggs and chick weight (P<0.01), hatchability on fertile eggs and percent chick weight (P<0.01), hatchability on set eggs and egg weight (P<0.01), hatchability on set eggs and chick weight (P<0.01), hatchability on set eggs and percent chick weight (P<0.01), egg weight and chick weight (P<0.01), egg weight and percent chick weight (P<0.01),chick weight and percent chick weight (P<0.01) and fertility and normal chicks (P<0.05). Some significant negative correlation were observed between dead in germ and hatchability and fertile eggs (P<0.01), dead in germ and hatchability on set eggs (P<0.01), hatchability on fertile eggs and dead in shell (P<0.01), hatchability on set eggs and dead in shell (P<0.01), normal chicks and abnormal chicks (P<0.01), fertility and abnormal chicks (P<0.05).

White Rock (WR) : Significant positive correlation was found between fertility and hatchability on fertile eggs (P<0.01), fertility and hatchability on set eggs (P<0.01), hatchability on fertile eggs and hatchability on set eggs (P<0.01) and egg weight and chick weight (P<0.01). Some significant negative correlations were observed between dead in germ and hatchability on fertile eggs (P<0.01), dead in germ and hatchability on set eggs (P<0.01), hatchability on fertile eggs and dead in shell (P<0.01), hatchability in set eggs and dead in shell (P<0.01), egg weight and percent chick weight (P<0.01), chick weight and percent chick weight (P<0.01) and normal chicks and abnormal chicks (P<0.01)

Discussion

Effect of hen of different breeds on hatchability traits: For genotypic variation little variation observed for egg weight. An apparent higher egg weight in WLH than in RIR, BPR and WR seems contradictory to general belief of higher egg weight in heavier breeds, Such a difference however, impress that relative egg in relation to breed may vary according to population. Highest fertility recorded for light breed WLH than in other breeds in the current study is supported by Tam and Wong (1974) and Reddy *et al.* (1965). Tam and Wong (1974) compared fertility among Cantonese, Wai Chow, White Leghorn (WLH) and New Hampshire (NS) where the fertility were 84.30, 83.62, 89.59 and 88.95% respectively. Reddy *et al.* (1965) reported fertility of WLH, RIR and WR showed 87.10, 76.30 and 69.40% respectively. Difference of fertility among batches (in different periods) agrees with Jayarajan (1992). Differences in hatchability on total eggs and lack of differences in hatchability on fertile eggs among genotypes signify that in this study hatchability on total eggs recorded was just a function of fertility. This finding of hatchability on fertile eggs agree with Chaudhry Alvi (1967) who found no significant difference in hatchability on fertile eggs between breeds of Rhode Island Red and New Hampshire (P>0.05). It also agrees with Reddy *et al.* (1965) who found that the higher hatchability for WLH (66.80%) than for other breeds (RIR, 59.60% and WR, 44.10%) on set eggs. But, the obtained results differ with Luztre *et al.* (1969). Swan (1977) reported higher percentage of hatchability (both fertile and set eggs) in meat strain than that in egg strains which also differ with the finding of present study. Batch differences found may possibly be attributed to difference in managemental practices and environment (Kalita, 1984; Card and Neshim, 1978; Robertson, 1961; Orszagh and Micek, 1961; Bohren *et al*., 1969 and Farnswarth and Warren, 1962). Lack of influence of breed and significant effect on batch in dead in germ (DG) impress that DG may be less dependent on genetic background rather may be more influenced by management and environment. Such a result agrees with Khalil (1960) who stated that embryonic mortality in Fayoumi eggs were 6.1, 2.7 and 14% during 3 weeks of incubation due to seasonal variation. Present findings differ with the Byerly and Olsen (1934). They reported that embryonic mortality (dead in germ) was highest in WLH than in RIR observed in 1st 3 days of incubation. As DG, dead in shell (DS) also had little relation with breed, but variation among batches indicating more dependence of DS to management and environment. This result also is similar with Patil *et al.* (1979) and contradicts to Jull (1951). Patil *et al.* (1979) reported seasonal variation (high temperature of environment) increased embryonic mortality (DS). Jull (1951) reported genetic constitution had some effect on embryonic mortality providing good feeding management and maintaining optimum condition. Number of sound normal chicks is an indication of success of hatchability. The results showed no significant difference among breed and batch was observed. No significant deviation in abnormal chicks among breeds, give an assumption that genetic background may have little influence on chick abnormality rather may be more a function of management and environment. Chick weight variation for genetic background recorded is supported by Raju *et al.* (1997). Raju *et al.* (1997) stated that day old chick weight increased significantly with increase in egg weight which may also be for the difference of genotype. The results impress that comparatively large size eggs always not resulted heavier chicks; breed may have a significant role. Thus the result also signifies that chick weight was not just a function of egg weight, but it was altered by genetic background and it was in favor of heavier breeds; Barred Plymouth Rock and White Rock.

Correlation among hatchability traits: The present study impresses significant positive correlation was shown for all breeds between fertility and hatchability on fertile eggs; fertility and hatchability on set eggs, hatchability on fertile eggs and hatchability on set eggs; egg weight and chick weight. Positive correlation for WLH and RIR for fertility and egg weight; fertility and chick weight; fertility and percent chick weight; fertility and normal chicks; egg weight and hatchability on fertile eggs; hatchability on fertile eggs and chick weight; hatchability on fertile eggs and percent chick weight; hatchability on set eggs and egg weight; hatchability on set eggs and chick weight; hatchability on set eggs and percent chick weight; egg weight and chick weight; egg weight and percent chick weight, but only WLH showed positive correlation than others for Hatchability on fertile eggs and normal chicks; hatchability on set eggs and normal chicks; egg weight and normal chick; chick weight and normal chicks; percent chick weight and normal chicks. Some negative correlation among BPR, WLH, RIR and WR for dead in germ and hatchability on fertile eggs; dead in germ and hatchability on set eggs; hatchability on fertile eggs and dead in shell; hatchability on set eggs and dead in shell. And also negative significant correlation observed in BPR and WR followed by those of WLH and RIR. Negative significant correlation between normal and abnormal chicks was observed in BPR, RIR, WR. The positive correlation of egg weight with chick weight regardless of breed found are well understood. Such egg weight related chick weight noted agrees with Salahuddin *et al.* (1995). Salahuddin *et al.* (1995) obtained heavier chicks from larger eggs for *deshi* chicken. Very peculiarity of the findings of this experiment is that there were positive correlation between egg weight and percent chick weight; chick weight and percent chick weight in WLH and RIR, while correlation for the same were negative in case of BPR and WR , indications an interaction of breed and egg weight on percent chick weight. Such information is not available in literature to compare with the results of the current findings. A positive correlation of egg size with fertility and hatchability was found only for WLH and RIR, while fertility and hatchability had little relation with egg weight. This result partially agrees with Salahuddin *et al.* (1995) who recorded higher fertility and hatchability of heavier eggs in *deshi* chicken. Moreover, this study impress that such a relationship may not be applicable to all breeds. It is evident from Table 2 to 5 that chick weight, percent chick weight had a positive correlation with fertility and hatchability for WLH and RIR, but not for BPR and WR indicating that such relation may differ with breed. The correlation figures also impresses that only in WLH, the hatchability and egg weight were endowed with the advantage producing more normal chicks.

Conclusion: Considering the overall hatchability traits it is concluded that breed have little effect on hatchability of fertile eggs in fowl. Fertility and hatchability on total eggs is significantly higher in White Leghorn compare to White Rock, Rhode Island Red and Barred Plymouth Rock under Bangladesh condition. The WLH appeared to have more positive correlation on hatchability parameters than the other breeds.

Acknowledgement

The authors wish to express his sincere and deepest sense of gratitude, heartiest appreciation and profound regards to Dr. Q. M. E. Huque, Director General, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh for providing financial assistance and others necessary facilities to implement the research work at the premise of the BLRI.

References

Ali, M. I., M. A. Wahid, M. A. R. Howlider and T. Yeasmin, 1993. Reproduction and growth of Rhode Island Red (RIR), Fayoumi (FO) and RIR X FO chickens in Bangladesh. Poult. Adviser, 26 : 47-50.

Auxilia, M. T. and C. Mastrorillo,1968. Relationship between the shape index and hatchability of eggs. Anim. Breed. Abstr., 33: 490.

Bohren, B. B., L. B. Crittenden and R. I. King, 1969. Hatching time and hatchability in the fowl. Poult. Sci., 40: 620.

Byerly, T. C. and M. W. Olsen, 1934. Causes of the embryonic malposition head under left wing. Ind. J. Poult. Sci., 15: 158-162.

Card, L. E. and M. C. Neshim, 1978. Poultry production, 11th edition (Reprinted), Lea and Febiger, Philadelphia, New York. pp: 106-113.

Chaudhry, M. R. and M. S. Alvi, 1967. Comparative study of fertility and hatchability of New Hampshire and Rhode Island Red breeds of chicken. Anim. Breed. Abstr., 39: 383.

Coony, W. T.,1943. Pre-incubation humidity variation effects on chicken eggs hatchability. Oreg. Agricultural Experimental Statistical Technology Bulletin, Fertility and hatchability, Wileg and sons, Inc., New York.

Demmining, D. C. and J. H. V. Middelkoop, 1999. Effect of strain and flock age on fertility and early embryonic mortality of broiler breeder eggs. Br. Poult. Sci., 40: 522-526.

Farnsworth, G. M. and D. C. Warren, 1962. Effect of age and turning on hatchability of eggs. Calif. Poult. Sci., 41: 1642.

Hutt, F. B.,1949. Genetics of fowl. McGraw Hill Book Company. Inc., New York, pp: 590.

Hutt, F. B., 1938. The Geneticists objectives in Poultry improvement. American Naturalists, 72: 268.

Jayarajan, S., 1992. Seasonal variation in fertility and hatchability of chicken eggs. Ind. J. Poult. Sci., 27: 36-39.

Jull, M. A., 1952. Poultry Breeding. Third Edition, John Wiley and Sons, New York. pp: 26,185-202, 237,267,325.

Jull, M. A., 1951. The genetic constitution of the breeding stock have some effect on embryonic mortality. Poultry Husbandry. Third edition. Mcgraw Hill Book Company Inc. New York, Toronto, London. pp: 158-159.

Jull, M. A., 1970. Considerable progress achieved in breeding for increased egg production in Egypt. World Poult. Sci. J., 26: 200-202.

Kalita, N., 1984. Effects of egg weight on hatchability. Poult. Guide, 22: 95-96.

Khalil, A. Z., 1960. Effect of crossing on fertility and hatchability of Fayoumi chickens. M.Sc. Thesis. University of Alexandria, Alexandria U.A.R. Cited from, Poult. Sci., 41: 1707-1712.

Luztre, G. H., A. B. Layugan, A. G. Navarpro, F. C. Bandong, P. N. Nonan and D. Avantre, 1969. The incubation performance of White Leghorn, White Rock and White Dominant Cornish at the Alabang Poultry Station. Anim. Breed. Abstr., 38: 500.

Olsen, M. W. and S. K. Hyne, 1948. The effect of different holding temperature on hatchability of hen egg. Ind. J. Poult. Sci., 27: 420.

Orszagh, V. and J. Micek, 1961. The effect of temperature variation during incubation on hatchability. Anim. Breed. Abstr., 33: 492.

Patil, N. A., M. Singh, and I. G. Chavan, 1979. Effect of month and strain variation on embryonic mortality. Anim. Breed. Abstr., 48: 393.

Raju, M. V. L. N., M. M. Chawak, N. K. Praharaj, S. V. R. Rao and S. K. Mishra, 1997. Interrelationships among egg weight, hatchability, chick weight, post-hatch performance and rearing method in broiler breeders. Ind. J. Anim. Sci., 67: 48-50

Reddy, V. B., D. Subbarayudee and P. Varadarajulee, 1965. The effect of breed, pre-incubation storage time and egg weight on hatchability of Poultry. Anim. Breed. Abstr., 34: 268.

Robertson, I. S., 1961. Studies on the effects of humidity on the hatchability of hen eggs. (i) The determination of the optimum humidity for incubation, (ii) A comparison of hatchability, weight loss and embryonic growth in eggs incubated at 40 and 70% relative humidity. Anim. Breed. Abstr., 30: 113.

Salahuddin , M., T. Yesmine, and M. A. R. Howlider, 1995. Relationship between fertility and hatchability with egg weight of free range native Bangldeshi chicken. Bangladesh J. Training and Dev., 8: 99-102.

Salauddin, M., A. Barua, N. Rashid and M. A. R. Howlider, 1990. Relationship between fertility and hatchability with egg weight of free range native Bangladeshi chicken. Poult. Guide, 28: 34-36.

Singh, D. K., C. S. P. Singh, L. B. K. K. Singh, and U. C. Singh, 1983. Studies on some fertility and hatchability characters in White Leghorn and White Rock chickens. Avian Res., 1978, 676 : 57-59. In: Poult. Abstr. (1986), 12: 106.

Swan, S. E. J., 1977. Fertility and hatchability of meat and egg strains of poultry in Fiji, Poult. Abstr., 3: 425.

Tam,Y. Y. and Y. C. Wong, 1974. Observation on fertility and hatchability of eggs. Poult. Abstr., 3: 216.

Warren, D. C., 1953. Practical Poultry breeding. The Macmillan Company, New York. p: 158.