Comparative Assessment of Fertility, Hatchability and Survivability of Bovan Nera ond Isa Brown Breeder Cocks Under Humid Tropical Conditions of Nigeria

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Abstract

The determination to identify a more productive, viable, adaptable and efficient breed of breeder cocks between two genotypes commonly used in the poultry industry to produce colour-sexed black and brown pullets necessitated this research work. There is the problem of productivity and viability with our commercial layers which could be a direct result of their parents' inability to adapt to the prevailing hot weather conditions. The two genotypes are: Isa Brown (IB) and Bovan Nera (BN). The number of breeder cocks evaluated in three separate batches per breed between 2002 and 2005 were 1690 and 1333 for IB and BN respectively. Performance records, in terms of fertility, hatchability and survivability were assessed in order to identify the more productive and viable breed for the zone. The observed general means for fertility and hatchability were 82.96% and 69.18%, respectively. Breed had a highly significant (P < 0.001) effect on fertility and hatchability. BN cocks recorded higher percent fertility and hatchability of 83.86% and 73.25% respectively, while IB cocks had fertility and hatchability values of 81.57% and 63.97%, respectively. Batch had no significant (P > 0.05) effect on fertility but positive influence (P < 0.01) was indicated for hatchability with Batch 1 having the highest percent fertility of 70.50%, while Batches 2 and 3 recorded mean values of 68.39% and 66.93%, respectively. Breed and batch had a highly significant (P < 0.001) effect on survivability (P < 0.01). BN cocks had lower mortality of 18%, when compared to their IB cocks which recorded 27%. Age of cocks also had a highly significant (P < 0.001) effect on fertility, hatchability and survivability. Percent fertility (84.70%) was highest in the 45 to 54 weeks age category, while hatchability (74.50%) peaked at 35 to 44 weeks of age. Mortality however, recorded highest percent value of 38% at 25 to 34 weeks age category. There was a significant interaction of breed and age effects on these reproductive traits (P < 0.01), implying that both traits were breed and age dependent. IB genotype had higher percent fertility and hatchability between 35-44weeks, while BN genotype recorded better results at 45 to 74 weeks. BN cocks recorded lower mortality rate throughout the age subdivisions than IB. BN cocks appeared hardier, productive and adapted to hot and humid climatic conditions. This breed showed genetic superiority in all the reproductive traits considered over IB genotype.

Keywords: Breed, Batch, Age, Fertility, Hatchability

INTRODUCTION

Poultry business becoming a profitable venture due to quick returns, employment and income generation notwithstanding the risks involved. However, the accrued benefits mostly depend upon the quality of the chicks produced from the breeder males and females. Fertility and hatchability are the two most determinants important for producing more chicks from given number of breeding stocks within a stipulated period (Islam et al., 2002a). This depends on genetic, physiological, social environmental factors (Jull, 1970; Warren. 1953). Fertility commercial flocks of breeders increased to a peak at 30 to 40 declined of age and thereafter (Hocking and Bernard, 2000). The yield of spermatozoa in caged males declined with age (Sexton et al., 1989). There is an body weight optimum maximum fertility in naturally mated (Hocking, 1990). Musculoskeletal diseases increased with age and body weight and may be associated with depressed fertility (Hocking and Duff, 1989). First-ofsequence eggs are associated with relatively low fertility (Robinson et al., 1991; Goerzen et al., 1996) and are more frequent both at the end of lay when clutch sequences are shorter, and at the start of lay. The relatively poor early fertility may

be as a result of more first-ofsequence eggs or of the relative behavioural or physiological immaturity of male and female birds (Hocking and Bernard, 2000).

In addition, Hocking and Bernard (1997a) reported that there were no differences in fertility between males of the same age but different maturity at the onset of lay. Duncan et al. (1990) reported that mating activity was high in young male and female broiler breeders and declined with age. Testosterone is associated with sexual activity (Culbert et al., 1977) and has been shown to decline after 30 weeks of age in caged broiler breeder males (Sexton et al., 1989; Renden et al., 1991). Jayarajan (1992) compared fertility and hatchability using 19,205 eggs of white Leghorn (WL), Rhode Island Red (RIR) and White Rock (WR) and reported that fertility was highest for WL and WR during the cold season and for RIR during summer.

This author also reported differences in fertility among batches of breeders reared during the period. Chandry and Alvi (1967) reported no significant difference (P > 0.05) in hatchability of fertile eggs between breeds of Rhode Island Red and New Hampshire. Islam et al. (2002b) reported breed differences on fertility. Sires from four breeds of

layers viz: White Leghorn, White Rock, Barred Plymouth Rock and Rhode Island Red had percent fertility values of 95.08%, 92.57%, 88.97% and 88.16% respectively. These authors however, reported no breed differences (P > 0.05) on hatchability. Islam et al., (2002b) also reported no significant (P > 0.05) effect of batch on fertility and indicated hatchability but significant interaction effect of breed × batch on fertility. There is information available influence of breed of cocks on fertility, hatchability and viability under natural mating as well as effect of age of males reproductive performance of breeders under Nigerian weather condition. This study undertaken to compare the fertility, hatchability and mortality of Bovan Nera (BN) and Isa Brown (IB) breeds of cocks reared in the humid zone of Nigeria. The study also evaluated the productivity of cocks under different ages.

MATERIALS AND METHODS

The data were collected from a multiplication breeding farm, Ajanla Farm (CHI LTD.), Ibadan, Southwest, Nigeria. The total number of male breeders involved in the study was 3,023, comprising of 1,333 for BN and 1,690 for IB cocks imported in three separate batches between 2002 and 2005. A batch refers to

the sequential order of placement of certain number of birds (cocks) on the farm at a specified period. The male breeders were imported at day-old from Europe and brooded under standard management conditions. They were raised on deep litter system and separated from their female mates until maturity (about 18 weeks). This was to prevent precocious and promiscuous mating normally witnessed in naturally-mated flocks.

The system was also to enable the cocks attain required body weight prior to egg laying by their female counterparts. These cocks were declawed to prevent injury during copulation. Prior to mating at maturity, sick birds and those with physical and genetic defects and poor growers were culled leaving healthy and sound birds to mate with mature hens. The feed composition was according to the production manual from parent company overseas. A total of 3,554,937 fertilized eggs collected from naturally-mated hens were taken into consideration. On a breed basis. 1.790.279 1,764,658 fertilized eggs collected from IB and BN cocks respectively, in three batches. After cleaning, only eggs of good shape and sound shell were placed inside incubator trays. On the 18th day, the eggs were candled to identify and

remove infertile eggs and eggs with embryos and on the 21st day, the number of normal chicks hatched was recorded and the percent fertility and hatchability were computed as follows:

% fertility: Number of fertile eggs × 100

Total number of eggs set %hatchability:Numberofeggs hatched×100 Number of fertile eggs

temperature and relative humidity during incubation were as follows:

- (a) Setting temperature: 99.75°F (1-18 days)
- (b) Hatching temperature: 99°F from 18-21 days
- Setting RH: 81-85%RH (1-18 days)
- (d) Hatching RH: 83-90% from 18-21 days

The incubator equipment was properly disinfected before after hatching.

The age was subdivided into five categories as follows: (a) Young (25-34 weeks); (b) Mature (35-44 weeks); (c) Old (45-54 weeks); (d) Very old (55-64 weeks) and (e) Aged (65-74 weeks) cocks.

Statistical analysis: The data were subjected to analysis of variance (ANOVA) and the significant differences between means were determined using Duncan's New Multiple Range Test option in SAS (2001). The statistical model used for fertility, hatchability survivability was:

 $Y_{ijkl} = \mu + G_i + B_j + A_k + (GB)_{ij} +$

 $(BA)_{ik} + (GBA)_{ijk} + \varepsilon_{ijkl}$ Where.

Y_{iikl} = Observation of the 1th population, in the kth age category, belonging to the jth batch, of the ith genotype; μ = Common mean; G_i = Fixed effect of Genotype (1, 2); Bi = Fixed effect of batch (1, 2, 3); A_k = Fixed effect of age (1, 2, 3, 4, 5); (GB)_{ii} = Interaction between genotype and batch; (BA)ik Interactions between batch and age; $(GBA)_{ijk}$ = Interactions between genotype, batch and age; ε_{ijkl} = Random error assumed to be randomly distributed $(0, \sigma^2)$.

RESULTS AND DISCUSSION

Fertility: The least squares means for cocks of Isa Brown (IB) and Bovan Nera (BN) are presented in Table 1. There was a highly significant effect of breed of cocks on fertility (P < 0.001). Bovan Nera cocks recorded higher percent fertility of 83.86±0.30%, compared to IB cocks that had 81.57±0.30%, during the period of observation which totaled 288 weeks of production. The batch effect on fertility was not significant (P > 0.05). However, age had a highly significant (P < 0.001) effect on fertility of breeder cocks. The mature (35 - 44 weeks), old (45 -54 weeks) and very old (55-64 weeks) cocks recorded 84.21 ± 0.46%, $84.70 \pm 0.46\%$ and $84.53 \pm$ 0.46% respectively, and they were superior to the young (25-34 weeks

Table 1: Least squares means of factors affecting fertility, hatchability and mortality of two breeds of cocks: Isa Brown (IB) and Bovan Nera (BN).

Factors	Fertility (%)	Hatchability (%)	Mortality (%)
Breed: BN	83.86±0.30 ^a	73.25±0.40 ^a	18±2 ⁶
IB	81.57±0.30 ^b	63.97 ± 0.40^{b}	27+2ª
Batch: 1	83.34+0.36°	70.50+0.49 ^a	22+3b
2	82.65+0.37ª	68.39+0.49b	14+3°
3	82.15+0.37 ^a	66.93+0.50 ^b	32+3ª
Age: 25-34	80.18+0.47 ^b	69.07+0.64°	38+4ª
(Weeks) 35-44	84.70+0.46a	74.50+0.62 ^a	31+4ab
45-54	84.70+0.46 ^a	72.24+0.62 ^b	23+4bc
55-64	84.53+0.46 ^a	$69.84 \pm 0.62^{\circ}$	15+4 ^{cd}
65-74	79.95±0.51 ^b	57.38±0.68 ^d	5+4 ^d

IB=Isa Brown; BN=Bovan Nera

^{a, b, c, d}=means in the same column with different superscripts are significantly different (P < 0.05)

and aged (65-74 weeks) cocks. The young and aged cocks recorded 80.18±0.47% and 79.95±0.51% respectively and were similar (P > 0.05). There were no significant differences in the fertility of eggs from mature (35 - 44 weeks), old (45 - 54 weeks) or very old (55 - 64 weeks) cocks. The significant breed effect reported on fertility in this study is in agreement with the findings of Islam et al. (2002a) on cocks of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock with percent fertility values of 88.97%, 95.08%, 88.16% and 92.57% respectively. In contrast, Ali et al. (1993) reported no significant (P > 0.05)effect of breed on fertility among Rhode Island Red (RIR), Fayoumi

(FO) and RIR × FO chickens. The non-significant (P > 0.05) effect of batch on fertility of set eggs was in conformity with the result of Islam et al. (2002b) on breed of cocks but contradicted Islam et al. (2002b) on breed of hen. Jayarajan (1992) also reported significant effect of batch on fertility which was at variance with the result obtained in this study. The similarity reported with the batches' performance may be attributed to uniform management practices during the production period. The batches were raised on the floor, given the same feeding and medication and housed in the location. The observed same differences in fertility among various age groups of cocks were not unexpected. The lower fertility

(80.18%) at young age (24-35weeks) may be attributed to the early stage of physiological maturity of the cocks which resulted in more infertile eggs being produced (Hocking and Bernard, 2000). Similarly, the lowest fertility (79.95%) of the aged (65 -74weeks) cocks was probably due to a decline in the production of spermatozoa or the onset of fertility (Sexton et al., 1989) which reduced mating activity (Duncan et al., 1990) with advancing age of the cocks. The result obtained in this study contradicted the findings of Hocking and Bernard (2000) who reported no significant differences in fertility between young and mature males of Cobb. According to Hocking and Duff (1989), musculo-skeletal diseases increased with age and body weight in chickens and this factor might have contributed to depressed fertility reported between 65-74 weeks of age.

The significant interaction (p<0.001) effects presented in Table 2 indicated breed × batch, breed × age, batch × age and breed × age × batch positive influence on fertility of breeder cocks. Table 3 however, reported the rank order of the breed's fertility performance as affected by age. IB cocks recorded higher percent fertility in 25 - 34 and 35 - 44 weeks while BN cocks were superior in 45 - 54, 55 - 64 and 65-74 weeks of age. BN cocks

were therefore, active and more productive with advancing age than IB cocks which were better at younger age.

Hatchability: There was a highly significant effect of breed on hatchability (P < 0.001). Bovine Nera cocks recorded a higher value of 73.25+0.40%, compared to IB cocks with a fertility value of 63.97+0.40% during the 288 weeks of production. The batch effect was also highly significant (P < 0.001). Batch 1 recorded the highest percent hatchability of 70.50 ± 0.49%) and was superior to batches 2(68.39 + 0.49%) and $3(66.93 \pm$ 0.50%). Batches 2 and 3 were however similar (P>0.05). Similarly, age had a highly significant effect on hatchability (P < 0.001). Cocks within the mature age group (35-44 weeks) recorded the highest percent hatchability (74.50±0.62%) and were superior to all other age groups (P < 0.05). The old (45-54) weeks) cocks with a percent hatchability of 72.24±0.62% was higher and superior to the young (25-34 weeks) with a percent hatchability of 69.07±0.64% and very old (55 - 64 weeks) with a value of 69.85±0.62%. The young and very old were very similar (P > The lowest hatchability of 57.38±0.68% was reported in aged cocks (65-74 weeks).

Table 2 showed the 1st and order interactions on

139

hatchability. There were highly significant (p<0.01) effects of breeds × age, breed × batch, batch × age and breed × age × batch on

hatchability of breeder cocks. This implies that hatchability of these breeder cocks depended on age, batch and breed of cocks.

Table 2: Analysis of variance table showing factors affecting fertility, hatchability and survivability of two breeds of breeder cocks.

	Df			MS		
_	Fertility	Hatchability	Mortality	Fertility	Hatchability	Mortality
Factors						
Breed	1	1	1	374.76 ^{xxx}	6141.16 ^{xxx}	0.54 ^x
Batch	2	2	2	33.89 ^{ns}	307.58 ^{xxx}	0.75 ^{xxx}
Age	4	4	4	325.20 ^{xxx}	2282.27 ^{xxx}	0.94 ^{xxx}
Breed×batch	2	2	2	286.58 ^{xxx}	261.14 ^{xxx}	0.22 ^{ns}
Breed × age	4	4	4	649.49 ^{xxx}	2029.86 ^{xxx}	0.24 ^x
Batch × age	8	8	8	322.30 ^{xxx}	465.04 ^{xxx}	0.09^{ns}
Breed×batch × age	8	Samuel Incomos	8	177.46 ^{xxx}	270.14 ^{xxx}	0.19 ^x

Ns: P > 0.05; x: P < 0.05; xxx: P < 0.001

Df: Degree of freedom

Ms: Mean square

Table 3 presents the rank order of the breeds in terms of hatchability performance. The significant effect of breed of cocks on hatchability reported in this study is in agreement with the findings of Islam et al. (2002a) on cocks but contradicted their findings on breed of hen. The results obtained also contradicted the findings of Ali et al. (1993) and Chandry and Alvi (1967) who

reported no significant (P > 0.05) effect of breed on hatchability. Breed differences could account for the disparity in results.

Similar to the fertility result, BN cocks were superior to IB cocks in terms of percent hatchability. The result of batch effect on hatchability agreed with the findings of Islam et al. (2002a) for hens, who reported significant (P<0.01) effect of batch on hatchabi-

lity

Table 3: Least squares means of genotype x age interaction effects on fertility, hatchability and survivability

		Traits		u faranta a constituidad de la c
Age	Genotype	Fertility	Hatchability	Mortality
Young	BN	77.59±1.04°	66.85±1.32 ^{ef}	39+6ª
(25 – 34 weeks)	IB	83.21±0.98 ^{cd}	71.75±1.25 ^{cd}	40 <u>+</u> 6 ^a
Mature	BN	82.20±0.98 ^{cd}	73.72±1.25°	19±6 ^{bc}
(35 – 44 weeks)	IB	86.21±0.98 ^{ab}	75.27±1.25 ^{bc}	19 <u>+</u> 6
Old	BN	87.84±0.98a	79.21±1.25 ^a	12 <u>+</u> 6°
(45 - 54)	IB	81.56±0.98 ^{cd}	65.27±1.25 ^f	34+6ab
weeks)		antipoo lu i		
Very old	BN	87.95±0.98 ^a	78.49+1.25ab	17 <u>+</u> 6°
(55 – 64 weeks)	adt mill	81.11 <u>+</u> 0.98 ^d	61.21 <u>+</u> 1.25 ^g	14 <u>+</u> 6°
11W 010051				
Aged	BN	84.66±1.06bc	69.29+1.35de	6 <u>+</u> 6°
(65 – 74 weeks)	IB	76.07±1.08°	46.77±1.38 ^h	4 <u>+</u> 6°

a, b,....g, h—means in the same column with different superscripts are significantly different (P < 0.05)

The differences in hatchability values reported in batches' performance might be due to differences in management and environmental conditions in the hatchery. The obtained result on age effect disagreed with the findings of Hockings and Bernard (2000) who reported that the age of male had no significant (P > 0.05) effect on hatchability. The mature

(35-44 weeks) cocks were more active in terms of mating activity which resulted in higher fertility rate and percent hatchability. The significant decline in percent hatchability from mature to aged cocks confirmed earlier findings that plasma testosterone concentrations in males declined from 30 to 60 weeks (Sexton et al., 1989). The lowest hatchability rate

between 65 and 74 weeks could be attributed to infrequent mating (Lill, 1966) leading to poor fertilization due to the declining quality semen (Lodge et al., 1974). The rank order indicated that IB cocks were more productive between 25 and 34 weeks than BN cocks while they both performed equally well in 35 and 44 week category. However, BN cocks were better and superior to IB cocks from 45 to 74 weeks in percent hatchability of fertile eggs.

Mortality: The least squares means for the two breeds were presented in Table 1. There was highly significant (P<0.001) effect of breed on mortality. IB cocks recorded 27±2%, while BN had a mortality of 18±2%. The batch highly effect was significant (P<0.001) on mortality. Batch 3 recorded highest mortality rate of 32±3%, while Batch intermediate with a mortality score of 22±3%) and Batch 2 was lowest, with a score of 14±3%). Similarly, there was a highly significant effect of age on mortality of the breeder cocks (P < 0.001). The young males recorded highest mortality rate of 38±4%, while the mature group recorded 31±4%), old category had 23±4%, very old category 15±5%) and the aged group had 5±4%. The percent mortality from 55 to 74 weeks was reasonably low (5 to 15%) compared to that between 25 and 54 weeks with a range of 23 to

38%. The interaction effects are presented in Table 2 and the rank order of the breeds' performance are contained in Table 3. The lower mortality rate reported for BN cocks indicated the hardiness and viability of the breed. The breed × age interaction effect revealed that BN cocks recorded significantly low percent mortality between 35 and 54 weeks and an insignificant difference in 25 to 34 weeks and 55 to 74 weeks. The significant differences reported for Batch effect on mortality could management and attributed to variations environmental which occurred during their productive years. The results obtained for the effect of age on mortality is in agreement with the findings of Malau-Aduli et al. (2003) who reported a significant effect of age of breeder cocks on mortality. It was observed that as the birds grew older, mortality rate declined.

Correlations between age and reproductive traits: Table 4 shows phenotypic correlations between age of the cocks and reproductive traits and between fertility and hatchability. Age had negative and highly significant phenotypic correlation (P < 0.001) with hatchability (r = -0.32) and mortality (r = -0.35). This implies that the reproductive traits have inverse relationship with age of There was declining cocks. mortality rate with advancing age.

Olawumi et al.

There was however, positive but highly significant phenotypic correlation (r = 0.85) between fertility and hatchability of fertile eggs. The results obtained are similar to the findings of Islam et al. (2002a) on four breeds of hen.

They reported significant positive phenotypic correlations of 0.56 between fertility and hatchability. Fertility is therefore, a good indicator of hatchability in breeder cocks' performance.

Table 4: Phenotypic correlations between age of the cocks and reproductive traits.

Factors	Age	Fertility	Traits Hatchability	Mortality
Age	1.00	0.01	-0.32 ^{xx}	-0.35 ^{xxx}
Fertility		1.00	0.85 ^{xxx}	0.02
Hatchability			1.00	0.11
Survivability		cks · cks		1.00

xxx. **D**<0.001

Fertility
- - Hatchability

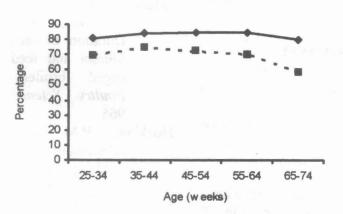


Fig 1. Effect of age on egg fertility and hatchability of both breeds of cocks

The effect of age on fertility and hatchability in IB and BN are shown in Figure 1. Fertility improved from 25 to about 60 weeks and declined gradually while hatchability was better between 25 and 60 weeks but declined sharply after 60 weeks. In general terms, fertility and hatchability showed a curvilinear pattern with age, increasing from young (25 to 34 weeks) to mature (35 to 44 weeks) and then declined thereafter

CONCLUSION

Genetic and non-genetic factors played greater roles in influencing the performance of the two breeds of cocks. BN cocks were hardier, productive and viable under the humid conditions of Nigeria. The BN cocks recorded significantly higher percent fertility and hatchability and lower percent mortality than IB cocks. The profitable and more productive age category was between 35 and 60 weeks.

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