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Effect of Seasons on the Reproductive Performance of Bovan Nera and Isa Brown Parent-stock Chickens in a Hot Humid Environment

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Abstract: Seasons play an important role in the performance of breeder chickens, but lack of adequate records on its specific effects in specific seasons could influence the efforts of breeders to improve on local ecotypes of chicken for standardization into breeds. This is why Nigeria still depends mainly on imported breeds of chicken for commercial production of chicken. In this study, the influence of Early Wet (EW), Late Wet (LW) and Early Dry (ED) and Late Dry (LD) seasons on reproductive parameters of Bovan Nera (BN) and Isa Brown (IB) parent-stock chickens were studied in the humid South-West Nigeria. Ten-year data on both genotypes were obtained from Ajanla Farms Hatchery Ibadan and analysed for Eggs Set (ES), Egg Fertility (EF), Egg Hatchability (EH), Pullet Day-old Chicks (PDC) and Hatching Rejects (HR) to study the effect of seasons on these parameters. ANOVA ($p<0.05$) showed that seasons have significant influence on EF, EH and HR in BN; and ES, EH and HR in IB. Late wet season gave the best results on reproduction thus making it potentially the most favorable season for hatching activities in both genotypes, and therefore may signal good fortune in commercial chicks production enterprises of breeder chickens in hot humid regions.

Keywords: Day-old pullet chicks, egg fertility, egg hatchability, layer birds, predictive-equations, tropics

INTRODUCTION

Poultry production has responded to the demand-supply gap in the protein requirement of humans for several years. To continue in this regard the effect of seasons on re-productivity is of interest to farmers and breeders alike. Many farmers and researchers believe that this effect is negligible on the over-all performance of poultry in the region. This belief has led to the lack of adequate records on poultry performance on many poultry farms and the paucity of information on this area of study for planners and researchers alike. This lack of records therefore militates against improvement efforts that could be put in place to improve breeder chicken performance in environments with multiple seasons such as in South-west Nigeria. An earlier study on the effect of season on fertility and hatchability of parent stock Bovans in Sudan-based on a two-year record-concluded that there was no significant ($p>0.05$) effect of different seasons on fertility and hatchability (Babiker and Musharaf, 2008). This study aims to re-examine the effect of seasons on reproduction in chickens with a view to broaden the current knowledge on the effect of seasons on the reproductive performance of breeder chicken especially under humid tropical environment. The hypothesis tested was that chicken productivity is not significantly affected by multiple seasonal changes in the hot-humid tropics.

MATERIALS AND METHODS

Farm records on the reproductive performance of parent stock Bovan Nera (BN) and ISA Brown (IB) strains, over ten years (1999-2008), were collected from Ajanla farms, Ibadan, Nigeria. Data obtained included: number of eggs set, number of eggs fertile, number of eggs hatched, number of good pullet day-old chicks, number of total rejects. Parameters studied were Egg Set (ES), Egg Fertility (EF), Egg Hatchability (EF), Pullet Day-old Chicks (PDC) and Hatching Rejects (HR). These were estimated as follow: Egg set (%) = 100 (total eggs set/total eggs received); Egg fertility (%) = 100 (total fertile eggs/total eggs set); Egg hatchability (%) = 100 (total eggs hatched/total eggs set), Pullet day-old chicks (%) = 100 (total viable pullet chicks/total eggs set) and Hatching rejects (%) = 100 (total rejects/total eggs set). Data were subjected to descriptive, Duncan multiple range and ANOVA statistics ($p<0.05$) of SAS (1999) and SPSS (2009) packages for analyses. Experimental design was randomized complete block. Seasons used for evaluation were according to the pattern of atmospheric temperature and rainfall in the region namely Early Wet (EW, April-July); Late Wet (LW, August-October); Early Dry (ED, November-January); and Late Dry (LD, February-March) seasons. Actual Predictive Ability (APA) Index of equation for each genotype under each

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season was estimated by the relation: APA = 100 (predicted value/observed value).

RESULTS AND DISCUSSION

Table 1 shows the summary of weather parameters of the region for the period covered by the data collected (1999-2008). The result shows that there were significant ($p<0.05$) differences between seasonal rainfall, temperature and relative humidity values. Thus, the seasons were highly distinct from each other. It has also been established that high temperature has adverse effect on poultry egg fertility and hatchability (Boone and Huston, 1963; Babiker and Musharaf, 2008).

Table 2 shows the effect of seasons on means of reproductive traits in both genotypes between the ages of 25 to 75 weeks, for the ten-year period. ANOVA ($p<0.05$) shows that seasons significantly influenced parameters, except egg fertility (IB), egg set and Pullet day-old chicks (BN) under investigation.

Percent eggs set: Between seasons, there were significant differences in eggs set in Isa brown but there was none in Bovan nera. Seasonal effect was significantly manifest in ED season (92.37) and LW season (91.44), followed by EW and LD seasons respectively in IB.

The high mean eggs set (90.47-98.50) is an evidence of the good egg handling procedures employed which resulted in least egg damage during egg sorting and egg setting stages in the hatchery. Most reports fail to notice this aspect of human influence on mass incubation of poultry eggs.

Percent egg fertility: Within strains, ANOVA showed that seasons influenced fertility significantly in BN, as LW season showed significantly ($p<0.05$) higher egg fertility (91.21) than LD season (85.43), followed by ED season (82.65) and EW season (80.68) in decreasing order. However, within IB, season did not show significant ($p>0.05$) effect on egg fertility. Fertility value was highest in LW probably because it recorded the lowest parameter values in Sunshine hours (6.17), Wind speed (2.10 km/h) and Temperature (25.24°C). These conditions coupled with the favorable high atmospheric humidity (82%) complemented egg fertility stability in the incubator compared to other seasons. The fertility figures (%) in both BN and IB in this study was higher than 81 obtained in Red-legged Partridge (Gonzalez-Redondo, 2006) and 73 in black Nera (Akanni *et al*., 2008); but the all-year mean was comparable to 85 reported in Normal feathered local chicken, and lower than 88.65 reported in Bovans layer by Babiker and Musharaf (2008). Except LD season in BN, fertility figures in both strains were generally lower than 92, 91.1 and 94.5 reported for local, Rhode Island Red and Crossbred chickens in Tanzania (Malago and Baitilwake, 2009). The results from this study confirmed that reported by Jayarajan (1992) who demonstrated the effect of seasons on fertility in chickens when he reported highest egg fertility for White Leghorn and White Rock during the cold season (Dec-Jan) and Rhode Island Red during summer (March-May). It however contradicted the findings of Babiker and Musharaf (2008) that reported no significant effect of season on fertility in Bovans in Khartoum.

Percent egg hatchability: Within strains, significant differences ($p<0.05$) were observed between seasons as

Table 1: Mean seasonal weather parameters covering the period of production from 1999 to 2008 in the hot humid South-west Nigeria

Parameter	Early wet	Late wet	Early dry	Late dry	All-year
Period	April-July	August-October	November-January	February-March	
Rainfall (cm)	174.08±11.29[a]	174.43±16.30[a]	11.01±3.26[b]	41.29±8.75[b]	111.27±8.96
Sunshine (hours)	8.95±1.17[a]	6.17±1.07[b]	8.27±1.19[ab]	10.41±1.69[a]	8.33±0.63
Wind speed (Km/h)	2.78±0.20[b]	2.10±0.20[c]	2.26±0.21[bc]	3.57±0.26[a]	2.61±0.11
Temperature (°C)	26.37±0.21[c]	25.24±0.14[d]	26.99±0.14[b]	28.70±0.216[a]	26.63±0.14
Relative humidity (%)	79.53±0.68[a]	82.00±0.68[a]	66.37±1.36[b]	65.45±1.47[b]	74.51±0.83

Means across rows with different superscripts are significantly ($p<0.05$) different

Table 2: Influence of seasons on mean reproductive parameters (25-75 weeks) in Bovan Nera and Isa brown parent-stock breeder hens in South-West Nigeria

Parameters	Seasons	Early wet	Late wet	Early dry	Late dry	All-year mean
Egg set	BN	98.10±0.83	99.10±0.25	98.38±0.54	99.19±3.35	98.50±0.39[a]
	IB	90.67±1.06[ab]	91.44±1.38[a]	92.37±0.42[a]	88.25±0.98[b]	90.47±0.56[b]
Egg fertility	BN	80.68±0.62[b]	91.21±4.31[a]	82.65±0.41[b]	88.43±1.06[ab]	84.07±0.95
	IB	87.11±1.75	88.37±0.42	87.78±3.14	82.22±1.02	86.91±1.16
Egg hatchability	BN	67.95±0.84[b]	75.63±0.73[a]	71.43±1.51[ab]	70.45±1.67[ab]	71.32±0.76
	IB	74.07±1.10[a]	73.57±0.57[a]	71.23±2.63[ab]	65.15±1.83[b]	71.18±1.03
Pullet DOC	BN	32.10±0.45	35.72±0.39	35.00±1.43	33.07±0.89	34.27±0.68
	IB	36.13±0.58[a]	35.60±0.31[ab]	34.68±1.29[ab]	31.72±1.42[b]	34.58±0.55
Hatching rejects	BN	0.89±0.02[b]	1.00±0.02[a]	0.79±0.02[c]	0.81±0.06[bc]	0.86±0.01
	IB	0.67±0.05[b]	0.89±0.04[ab]	0.74±0.03[b]	1.07±0.17[a]	0.85±0.04

Values with different superscripts across rows are significantly ($p<0.05$) different from each other

Table 3: Effect of genotype on seasonal reproductive parameters (25-75 weeks) in Bovan Nera and Isa brown parent-stock breeder hens in South-West Nigeria

Season	Strain	Egg set (%)	Egg fertility (%)	Egg hatchability (%)	Pullet DOC (%)	Hatching rejects (%)
Early wet	BN	98.10±0.83[a]	80.68±0.62[b]	67.95±0.84[b]	32.11±0.45[b]	0.89±0.02[a]
	IB	90.67±1.06[b]	87.11±1.75[a]	74.07±1.10[a]	36.13±0.58[a]	0.67±0.05[b]
Late wet	BN	99.10±0.25[a]	91.21±4.31	75.63±0.73	35.72±0.39	1.00±0.02[a]
	IB	91.44±1.38[b]	88.37±0.42	73.57±0.57	35.60±0.31	0.89±0.04[b]
Early dry	BN	98.38±0.54[a]	82.65±0.41[b]	71.43±1.51	35.00±1.43	0.79±0.02
	IB	92.37±0.42[b]	87.78±3.14[a]	71.23±2.63	34.68±1.29	0.74±0.03
Late dry	BN	99.19±3.35[a]	88.43±1.06	70.45±1.67	33.07±0.89	0.81±0.06[b]
	IB	88.25±0.98[b]	82.22±1.02	65.15±1.83	31.72±1.42	1.07±0.17[a]
Mean	BN	98.50±0.39[a]	84.07±0.95	71.32±0.76	34.27±0.68	0.86±0.01
	IB	90.47±0.56[b]	86.91±1.16	71.18±1.03	34.58±0.55	0.85±0.04

Values with different superscripts within seasons are significantly ($p<0.05$) different from each other

Table 4: Predictive (quadratic) equations for pullet day-old chicks hatched in Bovan Nera and Isa Brown parent-stock breeder hens in South-West Nigeria

Model	$Y = a + bX + bX^2$	$Y = a + bX + bX^2$
Seasons	Bovan Nera	ISA Brown
Early wet	$Y = 0.12 + 0.42X + 0.0007X^2$; $R^2 = 0.937$; APA = 1.001	$Y = -1.77 + 0.50X + 0.0001X^2$; $R^2 = 0.953$; APA = 0.982
Late wet	$Y = -3.71 + 0.52X + 0.00004X^2$; $R^2 = 0.935$; APA = 1.003	$Y = -2.69 + 0.52X + 0.00004X^2$; $R^2 = 0.925$; APA = 1.01
Early dry	$Y = 2.6 + 0.34X + 0.0013X^2$; $R^2 = 0.997$; APA = 1.01	$Y = -1.93 + 0.52X - 0.00004X^2$; $R^2 = 0.999$; APA = 1.014
Late dry	$Y = -0.45 + 0.41X + 0.0009X^2$; $R^2 = 0.968$; APA = 0.979	$Y = 11.45 + 0.05X + 0.004X^2$; $R^2 = 0.964$; APA = 1.041

Y: Pullet day-old chicks hatched (%); X: Egg hatchability (%); APA: Actual predictive ability

egg hatchability responded to seasonal influence. The highest value was recorded in LW season (75.63) in BN. This was followed by ED (71.43), LD (70.45) and EW (67.95) seasons respectively in decreasing order. In IB, hatchability was most influenced by EW and LW seasons (74.07 and 73.57). These were closely followed by ED (71.23) and LD (65.15) seasons respectively. The values obtained in this study were higher than 67.5 reported in Red-legged Partridge (Gonzalez, 2006); 52.2 and 64.0 in local Tanzanian and Rhode Island Red chickens (Malago and Baitilwake, 2009). The obtained values were however lower than 75.0 reported in B-Alpha (Akanni *et al*., 2008) and mean hatchability of total eggs in summer (77.13) and winter (74.9) in Bovans PS layers in Sudan (Babiker and Musharaf, 2008). The outcomes of this study contradicted that of Babiker and Musharaf in that there were significant differences between seasonal mean values. The differences in findings might be because the previous researchers employed a two-year data set in their analyses while a 10-year data set was utilized in the present study.

Percent pullet day-old chicks: In BN, percent pullet day-old chicks hatched were not affected by seasons. In IB however, Pullet production was most favorable in EW season (36.13). This was followed by LW (35.60), ED (34.68) and LD (31.72) seasons in descending order respectively. Thus, there were significant differences between seasons in IB, although average PDC production in both strains showed no significant difference.

Percent hatching rejects: Seasonal influence on HR discarded was significant in both strains. In BN, the highest amount was recorded in the LW (1.00), followed by 0.89, 0.81 and 0.79 in EW, LD and ED seasons respectively. In IB, rejects was highest in LW season probably due to the favorable weather conditions for optimal hatching and thus increased quantity of rejects.

Table 3 shows the influence of genotype on seasonal mean of parameters. Tukey's HSD test showed that genotype also influenced the results obtained, as genotypic means within EW and ED seasons differ from each other significantly. These results showed that within seasons, there was significant difference in ES, EF, EH, PDC and HR between BN and IB. This result was in line with Malago and Baitilwake (2009) who observed significant difference in hatchability among breeds of chicken in Tanzania.

Table 4 shows the stepwise predictive equations for pullet day-old chicks. Each equation for each season within each genotype revealed different intercept constant as influenced by respective season. The strongest constants were observed in ED (2.60) and LD (11.45) seasons in BN and IB respectively. All predictive equations gave very high R^2 (0.925-0.999) indicating the goodness of fit of the model for explaining the variability involved in Predicting pullet Day-old Chicks (PDC) production. All equations were tested for their Actual Predictive Abilities (APA). BN equations tended to over-estimate production at ≥80% and underestimate it at ≤40% hatchability in EW and LW seasons respectively. The ED season equation tended to over-estimate PDC at both low and high hatchability while LD season equation tended to over-estimate PDC production. In IB, different effects of seasons were observed on the equations. The EW season equation under-estimated PDC at all levels of hatchability; LW season equation over-estimated it at ≥73.00% hatchability and underestimated it at ≤62.00% hatchability. However, ED season equation under-estimated PDC at ≥75.00% but underestimated it at ≤58.00% hatchability. The LD season equation over-estimated PDC production at all levels of hatchability. The Actual Predictive Ability (APA) indices obtained from equations recommend them for use in predicting pullet production on farms in the region.

CONCLUSION

Results from this study showed the importance of seasons in chicken breeding. In Bovan Nera and Isa Brown, season had significant influence on egg fertility and egg hatchability respectively. In both genotypes hatching rejects was highly influenced by season. Chicken farmers might take advantage of Late-Wet season for highest commercial benefit in both genotypes. The predictive equations were adequate for predicting pullet day-old chicks' production.

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