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The Effect of Seasonal Variability on Fertility and Mortality Rates of Two Strains of Breeder Cocks in the Humid Tropics

Simeon O. Olawumi

Animal Breeding and Genetics Unit, Department of Animal Production and Health Sciences, Ekiti State University, Ado-Ekiti, Nigeria

Email address

olawumisimeon@yahoo.com

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Abstract

The present investigation was conducted to assess the impact of various weather conditions on fertility and mortality rates of two strains of breeder cocks in the humid zone of Nigeria. The seasons are early rain (ER), late rain (LR), early dry (ED) and late dry (LD). The two strains are Barred Plymouth Rock (BPR) and White Plymouth Rock (WPR). Analyzed data showed that strains differed ($P<0.01$) significantly in fertility rate. BPR genotype recorded superior percentage than WPR in fertility. In the case of mortality, the two strains did not differ significantly ($P>0.05$). With regard to season, the different seasonal subdivisions exerted varying degrees of influence on fertility rate. Both ER and LR favoured and enhanced fertility rate of breeder cocks than ED and LD seasons. This implies that more chicks were produced in the former than the latter. Similar to what happened to fertility during the seasons, dry season negatively impacted on mortality than rainy season. That is, more deaths were recorded in the ED and LD than ER and LR seasons. There was significant ($P<0.01$) strain x season effect on fertility and mortality. This implies that the two traits are strain and season dependent. BPR genotype performed well in all the seasons including dry seasons than WPR cocks. The former recorded higher percent fertility and lower percent mortality in both rain and dry seasons than the latter. For possible intervention in the industry, BPR genotype is recommended as genetic material in any breeding programme to upgrade the genetic potential of our indigenous chickens.

Keywords

Strain, Trait, Fertility, Mortality, Season

1. Introduction

Fertility in domestic animals is a measure of reproductive efficiency, and it is one of the parameters used by breeders to either cull or retain an animal for future breeding purposes. It is a quantitative trait, lowly heritable and influenced largely by the environment. Previous studies had proved that year, season and month of production have direct bearing on production and reproductive performance of animals. Chowdhury et al. (2004) observed that individual month and season influenced the hatchability of duck eggs. In addition, significant effect of month on egg production (Ipek and Sahan, 2004; Wohr and Erhard, 2005; Elsayed, 2009), fertility and hatchability (Elsayed, 2009) had been reported in Ostrich. In chickens, Malau-Aduli et al. (2003) found significant effect of age, year and season on egg production and mortality.

Similarly, significant influence of season on egg production (Bawa et al. 2001, Olawumi, 2011), fertility and hatchability (Olawumi, 2007) and mortality (Bawa et al., 2001; Olawumi, 2007) had been documented in literature. According to Gowe et al. (1993), egg fertility is generally considered a trait of both parents and their ability to interact and produce a viable zygote. In Ostrich, Elsayed (2009) observed steady increase in fertility rate from January to June and gradual decline thereafter.

In previously published data, Olawumi et al. (2008) documented that breed and age of breeder cocks had significant effect on fertility. The researchers also observed positive effect of breed and batch on mortality rate. Similarly, Sexton et al. (1989) noted that yield of spermatozoa in caged males declined with advancing age. While breed, age, batch effects on fertility of breeder cocks had been reported in literature, seasonal influence has not been given enough attention it deserves.

There is no doubt that prevailing environmental conditions exert much impact on mating activity, quantity and quality of sperm production. In effect, the success and sustainability of commercial chicks production depends on the reproductive performance of both male and female breeders. Fertility is one of the important reproductive traits determining how much chicks will be produced within a definite period of time. Poor fertility due to low sperm production as a result of age of cocks or disease infection will result to poor hatch, inadequate supply of chicks to market, high price of day-old chicks and high cost of production.

The humid zone of Nigeria is characterized by high temperature and relative humidity. Information is scarce in literature regarding the effect of season on fertility and mortality rates of exotic breeder cocks in Nigeria. The purpose of the present investigation was to determine the effect of season on reproductive traits of Barred Plymouth Rock and White Plymouth Rock breeder cocks reared for the production of sex-linked commercial day-old chicks in Nigeria.

The objectives include:

a. evaluating breed differences in fertility and mortality rates,

b. determining the particular season that favoured highest productivity,

c. identifying the season when productivity was low and the cause(s).

2. Materials and Methods

2.1. Site of Study

Data on fertility and mortality were collected from farm records of Ajanla Farms (CHI Ltd.), Ibadan covering a period from 2002 - 2005. Ibadan is situated at an elevation of 200m above sea level and lies about $7^0 28^1$ and $3^0 54^1$. The city enjoys two distinct seasonal periods namely, rain (May-October) and dry season (November-April). The minimum and maximum temperatures on average during the year are 20°C and 30°C, respectively.

2.2. Parent Stocks and Farm Management

The strains of breeder cocks studied are Barred Plymouth Rock (BPR) and White Plymouth Rock (WPR), and were managed on deep litter throughout the production period for natural mating at ratio 1male:10females. A total number of 3000 male breeders comprising of 1300 BPR and 1700 WPR cocks reared together with females in three separate batches were used in this study. The cocks were declawed to prevent injury during copulation, and were separated from the females during growing (rearing) period until about two weeks to the laying time. This method was adopted to prevent pre-cocious mating and it afforded the cocks an opportunity to reach the prescribed weight and maturity. Management practices on the farm during the observed period were uniform. Cleanliness, bio-safety and bio-security measures were strictly adhered to, while vaccinations against viral diseases were administered as and when due.

A total number of 3,554,937 fertile eggs comprising of 1,790,279 and 1,764,658 eggs were collected from WPR and BPR cocks, respectively. After disinfecting the incubator, clean and sound eggs were placed in the egg trays inside the incubator. On the 18^{th} day, incubated eggs were pulled out, candled and all infertile and dead in shell were removed from setter.

Fertility percent was determined on the candling (18^{th}) day as follows:

$$\text{Fertility \%} = \frac{\text{total number of fertile eggs} \times 100}{\text{total number of eggs set}}$$

Season was subdivided into four namely, early rain (ER: May-July), late rain (LR: August-October), early dry (ED: November-January) and late dry (LD: February-April).

2.3. Hatchery Management

Temperatures and relative humidity during incubation were as follows:

a. Setting temperature - 99.75^0F (1-18days)

b. Setting humidity - 83%RH (1-18days)

c. Hatching temperature - 99^0F (19-21days)

d. Hatching humidity - 85%RH (19-21days)

2.4. Data Analysis

Data collected were subjected to analysis of variance using the General Linear Model (SAS, 2001), and the significant differences between means of seasons were determined by Duncan New Multiple Range Test of the computer package

The appropriate statistical model used for fertility and mortality was:

$$Y_{ijk} = \mu + S_i + T_j + \varepsilon_{ijk}$$

Y_{ijk}= Observation of the j^{th} population, of the i^{th}season and J^{th} strain

μ= common mean

S_i= fixed effect of season (i=4)

T_j= fixed effect of strain (j=2)

ε_{ijk}= random errors assumed to be normally and independently distributed with zero mean and common variance.

3. Results and Discussion

In the present study (Table 1), strain of cock has significant ($P<0.01$) effect on fertility and mortality rates. Barred Plymouth Rock (BPR) recorded superior mean values than White Plymouth Rock (WPR) in fertility throughout the seasonal periods considered in this study. With regard to season's influence on fertility (Table 1), significant ($P<0.01$) differences were found among the various seasonal sub-divisions. The highest mean values was recorded for late rain

(LR), followed by early rain (ER), while early dry (ED) was third and late dry (LD) has the lowest mean values. Also, in the current study (Table 1), season has significant (P<0.01) effect on the mortality of breeder cocks. Early dry (ED) season recorded higher mortality rate than other seasonal subdivisions in this zone. This is followed by late dry (LD), while rainy season had the lowest percent mortality.

In Table 2, strain x season interaction effects on fertility and mortality rates of the two strains of cocks was presented. This refers to the ranking order of strains in order of performance in different seasons. As per percent fertility, BPR genotype recorded higher percent fertility in ER, LR and ED than WPR cocks. But in LD, both strains did not differ (P>0.05) significantly in percent fertility.

In general, there are many genetic and non-genetic or environmental factors which affect fertility and mortality of breeder cocks. These include breed or strain, nutrition, obesity, health and physiological factors (Olawumi et al., 2008).

In the current study, Barred Plymouth Rock cocks showed superiority in terms of fertility rate than White Plymouth Rock. The result was in conformity with the observations of Olawumi et al. (2008) who found significant differences in fertility between strains of cocks. The high productivity of the former might be attributed to its hardiness and possession of genes capable of adjusting to fluctuating weather conditions.

Therefore, BPR genotype could be used as genetic material to upgrade the productivity of our local chickens. It is a well-known fact that production and regular supply of day-old chicks to farmers depend solely on fertility rate of breeders. Therefore, BPR strain with higher fertility rate will no doubt produce more chicks than WPR genotype, and should be adopted as a choice and suitable strain to use in any breeding programme aimed at increasing the performance and profit in the industry.

With regard to mortality rate, the two strains did not differ (P>0.05) significantly, that is, there was no statistically significant difference in their mean values. The result was in agreement with the observation of Olawumi and Dudusola (2012) who reported an insignificant effect of strain of commercial layers on mortality. However, at variance with the present data, Olawumi et al. (2008) found significant effect of strain of layer breeders on mortality rate.

Pertaining to season's effect on fertility, the two subdivisions within the rainy season produced more chicks than dry season going by the higher fertility rates recorded in the former. This was made possible as a result of lower temperature and favourable weather conditions that prevailed during rainy season which aided frequent mating between males and females in the pen where natural mating is being practiced. The lower fertility rate recorded in the dry season on the other hand could be as a result of harsh environmental and hot weather conditions which might have induced stress in the cocks leading to reduced sexual activity and mating frequencies. In conformity with the present data, Elsayed (2009) documented that fertility in Ostrich was influenced by the season of production. Further studies are suggested to be conducted on ways of ameliorating the effect of hot weather on performance of domestic chickens.

In the present data, the flock recorded high mortalities in the dry season than rainy season across strains. The more deaths observed in dry season might not be unconnected with high temperature and its attendant heat stroke which predisposed farm animals to stress, diseases and eventual death. It is imperative that a breed or strain of chickens be developed for the zone which is adaptable to hot conditions in order to increase the productivity of farmers and hatchery operators. Previous authors reported similar findings (Malau-Aduli et al., 2003). The researchers observed that more deaths were recorded during the dry seasons than rainy period.

With respect to interaction between strain and season, BPR genotype performed efficiently in all seasons than WPR cocks. This implies that the former was hardy, heat tolerant and adapted to hot weather conditions. The result was in agreement with the findings of Olawumi (2007) who reported significant stain x season interaction effect on the performance of two breeds of layer breeders in the humid tropics.

Table 1. *Least squares means showing the effect of strain and season on fertility and mortality rates of breeder cocks.*

Factors	Traits	
	Fertility (%)	**Mortality (%)**
Strains:		
BPR	84.04[a]	0.44
WPR	81.72[b]	0.49
SE	2.50	1.24
Season:		
ER	85.33[b]	0.44[b]
LR	87.93[a]	0.43[b]
ED	80.57[c]	0.61[a]
LD	76.94[d]	0.45[b]
SE	0.85	1.25

abcd means along columns with different superscripts are significantly different (P<0.01)
BPR-Barred Plymouth Rock WPR-White Plymouth Rock
ER-early rainLR-late rainED-early dry LD-late dry. SE- standard error

Table 2. *Least squares means showing strain x season interaction effects on fertility and mortality rates of breeder cocks.*

Factors	Strains	Season			
		ER	**ED**	**ED**	**LD**
Fertility (%)	BPR	86.44[b]	90.31[a]	81.91[c]	76.85[e]
	WPR	84.25[b]	85.55[b]	79.44[d]	77.05[e]
	SE	3.45	2.45	1.50	1.35
Mortality (%)	BPR	0.47[ab]	0.42[ab]	0.58[ab]	0.34[b]
	WPR	0.42[ab]	0.44[ab]	0.63[a]	0.58[ab]
	SE	0.85	1.45	1.85	2.45

abcde means along columns with different superscripts are significantly different (P<0.01)
BPR-Barred Plymouth Rock WPR-White Plymouth Rock
ER-early rain LR-late rain ED-early dry LD-late dry. SE- standard error

With regard to mortality rate, BPR strain had lower values when compared to WPR in ED and LD seasons. However,

both strains did not differ (P>0.05) significantly in ER and LR seasons. It was evident that fertility and mortality rates in breeder cocks are strain and season dependent. The best strain in this flock recorded superior and higher mean values in all seasons.

The present study reveal that BPR strain was good, productive, hardy and heat tolerant than WPR cocks. The former had higher fertility rate and lower mortality rates during all seasons covered by the study. It is recommended that BPR cocks be incorporated into breeding programme to improve the productivity of indigenous chickens.

4. Conclusions

- It was revealed from the results of this study that strain and season had significant effect on the productivity of breeder cocks.
- BPR genotype has superior mean values in fertility rate than WPR cocks. Also, the former has lower mortality rate than the latter.
- In addition, season has significant effect on both fertility and mortality rates of cocks. More chicks were produced during the cool, rainy season than hot, dry weather conditions.
- Regarding interaction effect, fertility and mortality rates are strain and season dependent. Dry and hot weather conditions exerted little impact on the performance of BPR strain when compared to WPR cocks.

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