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GENOTYPIC AND SEASONAL VARIABILITY ON THE REPRODUCTIVE PERFORMANCE OF TWO STRAINS OF HYBRID LAYERS IN SOUTHWEST NIGERIA

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Abstract

The egg-laying or layer strain is of high nutrient and of good economic importance to the society at large due mainly to its egg production traits and also for its meat. The exotic layer strains have been able to adapt to the climatic and environmental conditions of the southern part of Nigeria. Non-the-less, challenges are still being faced in its rearing and production especially during extreme climatic conditions. Previous research found that changes in the seasonal environment had significant effects on egg fertility, hatchability of total set eggs and hatchability of fertile eggs. This study aimed at determining the effects of genotype and season on two exotic layer chicken strains. A total of one thousand five hundred (1500) layers per strain were used for the evaluation of their reproductive performances. Each strain included one hundred and twenty cocks (120) for random mating. It was observed that there were significant differences ($P<0.05$) in the values obtained for the different seasons. The late wet season had a higher significant difference ($P<0.05$) in values of the percent fertile (78.12±0.51), percent hatched (72.36±0.74) and percent hatchability (92.92±0.36) than other seasons. the percent hatchability (90.60±0.48), total hatched (67.68±0.98), percent fertility (74.80±0.72), were highly significant ($P<0.05$) in Brown dominant than the Hyline brown strain of laying Chicken with percent hatchability (88.38±0.49), total hatched (63.01±0.92) and percent fertility (71.02±0.71). In conclusion, it was discovered that the Brown dominant layer chicken strain had a better performance in the fertility and hatchability than the Hyline brown chicken layer and the late wet season was observed to be more favourable to percentages hatched, fertility and hatchability. The Brown dominant strain is preferable for brown layer production and also, the late wet season should therefore be targeted for optimal production of layers in southwest Nigeria.

Keywords: Reproductive, performance, Brown, dominant, Hyline, Hatchability, Fertility, Strain, Season

EFFETS DE LA VARIABILITÉ GÉNOTYPIQUE ET SAISONNIÈRE SUR LA PERFORMANCE DE REPRODUCTION DE DEUX SOUCHES DE PONDEUSES HYBRIDES DANS LE SUD-OUEST DU NIGÉRIA

Résumé

La souche de poule pondeuse est très nutritive et revêt une importance économique pour la société dans son ensemble, principalement en raison de ses caractéristiques de production d'œufs et de sa viande. Les souches de pondeuses exotiques ont pu s'adapter aux conditions climatiques et environnementales de la partie sud du Nigéria. Néanmoins, des défis restent à relever dans leur élevage et production, en particulier dans des conditions climatiques extrêmes. Des recherches antérieures ont révélé que les changements de l'environnement saisonnier avaient des effets importants sur la fertilité des œufs, la capacité d'éclosion des œufs pondus au total et le taux d'éclosion des œufs fertiles. Cette étude visait à déterminer les effets du génotype et de la saison sur deux souches de poulets exotiques. Au total, mille cinq cent (1500) pondeuses par souche ont été utilisées pour l'évaluation de leurs performances reproductives. Chaque souche comprenait cent vingt coqs (120) pour un accouplement aléatoire. Des

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différences significatives (P <0,05) ont été notées au niveau des valeurs obtenues pour les différentes saisons. La fin de la saison humide a eu une différence significative plus élevée (P <0,05) au niveau des valeurs du pourcentage de fertilité (78,12 ± 0,51), du pourcentage d'œufs éclos (72,36 ± 0,74) et du pourcentage de capacité d'éclosion (92,92 ± 0,36) par rapport aux autres saisons. Le pourcentage d'éclosion (90,60 ± 0,48), le total d'œufs éclos (67,68 ± 0,98), le pourcentage de fertilité (74,80 ± 0,72) étaient significativement (P <0,05) élevés chez la souche dominante Brown par rapport à la souche Hyline Brown de pondeuses aux performances suivantes : pourcentage d'éclosion (88,38 ± 0,49), total éclos (63,01 ± 0,92), pourcentage de fertilité (71,02 ± 0,71). En conclusion, il a été découvert que la souche de pondeuse dominante Brown avait une meilleure performance en matière de fertilité et d'éclosion par rapport à la pondeuse Hyline Brown, et la fin de la saison humide s'est avérée plus favorable aux pourcentages d'œufs éclos, de fertilité et d'éclosion. La souche dominante Brown est préférable pour la production de pondeuses brunes ; en outre, la fin de la saison humide devrait donc être ciblée pour une production optimale de pondeuses dans le sud-ouest du Nigeria.

Mots-clés : Reproductif, performance, Brown, dominant, Hyline, éclosion, fertilité, souche, saison

Introduction

The egg-laying or layer strain is of high nutrient and economic importance to the society at large due mainly to its egg production traits and also for its meat. The commercial layer is best known for table egg production because of the high level of genetic improvement in its laying performance and thorough management input (Ogbu, 2012). Hyline brown parent stock is expected to attain the weight of 1450 – 1530g with a feed intake of 81 – 85 g/day per bird at 18 weeks of age (Hyline, 2014). The Brown dominant strain is colour-sexed through silver-red S/s alleles of Silver gene. Brown dominant pullet at 18 weeks of age, with an average feed consumption of 79 g/day, is able to attain a body weight of 1450 to 1500g provided good management procedures and practices are adhered to (SochĹŻrek, 2008). At laying period, its livability is 95 – 97%.

Climate change is a natural process that takes place simultaneously on various time scales, in relation to the variation over time of the global climate or local climates, which may be the results of both natural forces and human activities (FAO, 2009). The exotic layer strains have been able to adapt to the climatic and environmental conditions of the southern part of Nigeria, non-the-less, challenges are still faced in its rearing and production especially during extreme climatic conditions. These challenges include; the effects of heat stress that has resulted in increased mortality of the birds, susceptibility to infections and diseases, drop in daily egg production, decrease in hatchability and fertility among others.

Heat stress has negative effects on both hatchability and fertility in poultry production. Previous research demonstrated that high environmental temperatures commonly called heat stress adversely affected egg production, fertility (McDaniel *et al*., 1995; Obidi *et al*., 2008) and hatchability (Lourens *et al*., 2005) of breeders. This was in line with other research work that showed that changes in the seasonal environment had significant effects on egg fertility (Aggarwal, 1987; Pruthi and Aggarwal, 1987; Das and Ali, 1999), hatchability of total set eggs (Farooq *et al*., 2003; Chowdhury *et al*., 2004), and hatchability of fertile eggs (Kalita *et al*., 1985; Sreenivasaiah and Joshi, 1987) in poultry and ducks.

Nigeria, like the rest of West Africa and other tropical lands, has only two seasons. These are the dry and the rainy seasons (Oguntunji *et al*., 2008). The Nigeria season has also been further divided into four by many researchers as; January – March being Late Dry season, April – June being Early Wet season, July – September being Late Wet season, October – December being Early Dry season (Adedeji *et al*., 2006). The seasonal variability is prevalent in the entire landscape of Nigeria including the southwest region. The seasons are therefore targeted by poultry farmers during their production cycle to maximise performance.

The objective of this study was to

determine the effects of genotype and season on two exotic layer chicken strains; Brown dominant and Hyline brown, and to compare their performances in the different seasons of the year.

Materials and Methods

Experimental Site

The study was carried out in a poultry breeding farm, located in Igboora, Oyo State, South-Western, Nigeria. Igboora is a town situated 80 km North of Lagos State with coordinates 7°26'10" N and 3°17'34" E. The vegetation of the area is typical of a Sahel savannah with two main seasons consisting the rainy and dry seasons.

Experimental Birds

Two strains of hybrid layers were used for this study; Brown dominant and Hyline brown. The birds were housed separately per genotype in a deep litter system of the production unit of the farm. Small wooden cages were provided in the pen for egg collection.

Egg collection, incubation and management

A total of one thousand five hundred (1500) layers per strain were used for the evaluation of their reproductive performances. Each strain included onehundred and twenty (120) cocks for random mating. Egg collection started when the layers were thirty (30) weeks old. Four hundred (400) eggs per strain (Brown dominant and Hyline brown) were collected for incubation per week (nine weeks per season) throughout the duration of the study. The four seasons under consideration were early wet, late wet, early dry and late dry. A total of three thousand six hundred (3600) hatchable eggs per strain were collected per season from the Breeder farm in Oyo state. The eggs were grouped to differentiate between batches and stored in the cold room at a temperature of 17°C prior to setting in the incubator. Before setting in the incubator, the eggs were sorted, arranged into trays and then aligned into trolleys. The eggs were positioned in the trays with the broad ends up to allow for ease of gas exchange (CO2 and O2) between the eggs and the environment. The trolleys were then moved to the fumigation chamber where the eggs were fumigated using formaldehyde (40%) and potassium permanganate crystals at a ratio of 2:1.

The hatchery unit is automated with a two stage incubation system, comprising the setters and the hatchers. After 18 days of incubation in the setter, the eggs spent a further 3 days in the hatcher. The temperature in the setters was set at 99.5°F and the relative humidity at 83.0% while the hatchers were set to a temperature of 98.5°F and 85.0% relative humidity. The ambient temperature was kept cool with air-conditioners installed in the incubator rooms. The setters allowed for the turning of the eggs at 60° hourly, sprinkling of humidified water, provision of heat to keep the air warm, the inflow of chilled water from the chiller to regulate the temperatur, and a damper to allow for the exchange of air between the inside of the incubator and the environment.

Candling of the eggs was carried out to determine the percentage fertility of the eggs on the 7th and 18th days of incubation. During the process, the eggs were separated into three groups; Fertile, Infertile and Dead-in-germ eggs, while records were taken on weekly basis.

After the candling operation, the fertile eggs were transferred into the hatchers in preparation for hatching. After hatching the chicks were grouped into three during counting and boxing and documented as follows: the normal chicks also termed real chicks, the reject chicks (abnormal chicks) and the dead-in-shell. Chicks which were under sized, poorly feathered, parrot beaked, blind, lame, and those with poorly absorbed yoke were considered and counted as rejects.

Estimation of percentage fertility, hatchability of fertile eggs, hatchability of set eggs and dead in shell

The percentage fertility, infertility, hatched, dead-in-Shell and hatchability were estimated using the formulae below:

$$\text{Fertility (\%)} = \frac{\text{Number of fertile eggs}}{\text{Total number of eggs set}} \times 100\%$$

$$\text{Infertility (\%)} = \frac{\text{Number of infertile eggs}}{\text{Total number of eggs set}} \times 100\%$$

$$\text{Hatchability (\%)} = \frac{\text{Number of eggs hatched out}}{\text{Total number of fertile eggs}} \times 100\%$$

$$\text{Hatched (\%)} = \frac{\text{Number of eggs hatched out}}{\text{Total number of eggs set}} \times 100\%$$

$$\text{Dead-in-Shell (\%)} = \frac{\text{Number of Dead-in-Shell}}{\text{Total number of fertile eggs}} \times 100\%$$

Statistical analysis

Data obtained were analysed using the General Linear Model of SAS (2009). After the removal of non-significant interactions, the following model was used:

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

Where, Yij = an observation of the trait (%Fertility, %Hatchability etc.),
μ = Overall mean
S_i = Effect of Strain (Brown dominant, Hyline brown)
T_j = Effect of Season (Early wet, Late wet, Early dry, Late dry)
ε_{ij} = Random error

The significant differences among treatments were determined by Least Significant Difference (LSD) test.

Statement on the welfare of the animals

Ethical approval:

The experiment was conducted following the code of ethics for animal experimentation with prior approval by the University's Animal Ethics Committee.

Table 1: Effect of genotype on reproductive performance of both Brown dominant and Hyline brown strains of laying Chicken

Parameters	Brown dominant	Hyline brown
%Infertile	25.20±0.73[b]	28.99±0.71[a]
%Fertile	74.80±0.72[a]	71.02±0.71[b]
%Hatched	67.68±0.98[a]	63.01±0.92[b]
%D.I.S.	9.40±0.48[b]	11.62±0.49[a]
%Hatchability	90.60±0.48[a]	88.38±0.49[b]

[a, b] – means on the same row having different superscripts are significantly (p<0.05) different, D.I.S. – Dead in shell

Table 2: Effect of season on reproductive performance of both Brown dominant and Hyline brown strains of laying Chicken

Parameters	Late Dry	Early Wet	Late Wet	Early Dry
%Infertile	31.68±0.58[a]	27.43±0.92[b]	21.88±0.51[c]	27.39±1.01[b]
%Fertile	68.33±0.58[c]	72.58±0.91[b]	78.12±0.51[a]	72.62±1.01[b]
%Hatched	59.37±0.75[c]	65.55±1.10[b]	72.36±0.74[a]	64.12±1.32[b]
%D.I.S.	12.96±0.59[a]	10.09±0.56[c]	7.09±0.36[c]	11.91±0.61[a]
%Hatchability	87.04±0.59[c]	89.91±0.56[b]	92.92±0.36[a]	88.09±0.61[c]

[a, b, c] – means on the same row having different superscripts are significantly (p<0.05) different, D.I.S. – Dead in shell

Results

The effect of genotype on the reproductive performance of both layer birds

The effect of strain on the reproductive performance of both Brown dominant and Hyline brown is presented in Table 1. The result shows that the percent hatchability (90.60±0.48), total hatched (67.68±0.98), percent fertility (74.80±0.72), were significantly higher (P<0.05) in Brown dominant compared to Hyline brown strain of laying Chicken. However, the percent infertile (28.99±0.71) and percent dead-in-shell (11.62±0.49) were significantly higher (P<0.05) in Hyline brown than in Brown dominant.

The effect of season on the reproductive performance of both layer birds

The effect of season on the reproductive performance of both Brown dominant and Hyline brown is presented in Table 2. It was observed that there were significant differences (P<0.05) in seasonal variability. The late wet season was significantly higher (P<0.05) in values for the percent fertile (78.12±0.51), percent hatched (72.36±0.74) and percent hatchability (92.92±0.36) than other seasons. This was closely followed by the early wet season.

Discussion

The effect of genotype was highly significant as found in this study. The Brown dominant strain had a better reproductive performance in the percentage hatchability, fertility and hatched when compared to the Hyline brown which on the other hand had a significantly higher percentage in the total infertile, rejected chicks and dead-in-shell. This is in line with the works of Sola-Ojo and Ayorinde (2011) and Ndofor-Foleng (2015) whose results recorded significant effect of genotype on fertility and hatchability. The significance effect of genotype recorded in this study could have also be as a result of the acclimatization of the Brown dominant to the Nigerian environment since they have been used for production in the research farm for a longer period than the Hyline brown which were recently introduced into Nigeria from the United Kingdom to supplement the production of brown chicks in the breeder farm. It has been reported by Dauda *et al*. (2006) that the Nigerian climatic environment is characterised by high temperature and relative humidity typical of tropical regions which could negatively affect the physiological functions of birds.

The effect of season on reproductive performances of Brown dominant and Hyline brown was significant in the percent infertile, percent fertile, percent dead-in-shell, percent hatched and percent hatchability. The highest significant differences found in the percent fertile, percent hatched and percent hatchability productions were in the late wet season. This was closely followed by the early wet season. The percent infertile and percent dead-in-shell were highest in the early dry and late dry seasons. This could be as a result of the influence of season on fertility and hatchability (Olawumi, 2007) which made the lower temperature and favourable condition of the weather experienced during the wet season to give advantage to the reproductive performances of the layers while the harsh and hot environmental condition as a result of the dry season had a negative influence on the layers. The lower hatchability percentage recorded in the early and late dry seasons could be as a result of development of the embryo prior to incubation due to high environmental temperature which also weakens it. Jesuyon and Oseni (2015) reported that the best fertility and hatchability results were obtained in Black Nera and Isa Brown genotypes during the late wet season respectively. Also, earlier reports had also lay claim on the fact that reproductive performance of poultry was influenced by season. This is supported by Elsayed (2009) who reported that fertility in Ostrich was influenced by the season of production. Roy *et al*. (2003) also reported that season had significant effect on the fertility and hatchability of White Leghorn eggs. Similarly, Gonźalez-Redondo (2006) reported that laying date had influence

on the fertility and hatchability of red-legged Partridge (Alectoris rufa) eggs. This influence of season was also similar to the results obtained in the study for Brown dominant and Hyline brown layers.

The results revealed that genotype had significant effect on the reproductive performance as the Brown dominant chicken layer strain had a better performance in the fertility and hatchability than the Hyline brown chicken layer. It was also found from the study that season had significant effect on the reproductive performance of both strains of laying birds. The late wet season was observed to be more favourable to percentage hatched, percentage fertility and percentage hatchability. On the other hand, the late dry season had more impact on the percentage infertile and percentage dead-in-shell. It is therefore recommended that the Brown dominant strain is preferred for brown layer egg production in tropical condition and also that the late wet season should be targeted for optimal production of layers in southwest Nigeria.

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Conflict of interest statement

There is no conflict of interest with any individual or organization regarding the materials discussed in the manuscript.

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