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RESEARCH ARTICLE

Strain by Season Interaction Effects on Production Traits of Commercial Layers in the Derived Savannah Zone of Nigeria

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ABSTRACT

The aim of the present investigation was to rank the exotic strains of commercial layers vis-à-vis their performance at different seasonal sub-divisions. It is believed that animals differ in their productivity when reared in different environmental conditions. The strains of birds under investigation were Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB), and the different seasonal periods were early rain, late rain, early dry and late dry seasons. Records of egg production, feed intake and mortality for individual strain were taken on daily basis between August, 2007 and September, 2008 (56 weeks). Analyzed results showed that there was significant strain by season interaction effects on egg production, mortality and feed efficiency. With regards to egg production, IB was superior to all the other two strains, that is, ranked first in all seasons, BN recorded intermediate mean values, while DB ranked third in performance. The study also revealed that IB recorded lower mortality in all seasons compared to BN and DB. This implies that IB still recorded first position and superior to other two strains in survivability. Similarly, IB has higher mean values in feed efficiency than BN and DB in all seasonal sub-divisions considered. The present study indicates that egg production, mortality rate and feed efficiency were breed and season dependent. IB strain appeared more productive, hardy, heat tolerant and feed efficient judging from its top performance in all seasons, that is, the strain ranked first in all the production traits regardless of weather conditions. For good and profitable business, IB genotype is recommended for farmers in this agro-climatic zone.

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INTRODUCTION

The productivity of animals depends to a large extent on its genetic constitution, and also on the environmental conditions which prevail in the vegetational zone where the animal lives. Significant genotype x environment interaction effects on egg production among four strains of commercial layers had been reported in earlier study (Gwaza and Egahi, 2009). It is generally believed that egg production and the rate of feed conversion to eggs or meat vary among strains of commercial layers (Zamans *et al*., 2004; Olawumi, 2011). Hossain (1992) also reported significant effect of breeds on egg production and feed efficiency. The fluctuating weather conditions typical of tropical region have been a source of concern to poultry farmers in this country because of its negative effect on birds' performance. In a laying flock, significant effect of season on egg production and mortality rate was documented (Bawa *et al*., 2001). Keener *et al.* (2006) posited that throughout the whole range of practical environmental temperature, laying birds have physiological responses that affect their productive performance.

The relationship between ambient temperature and egg formation and egg production had been much studied in birds. Previous investigation had reported decrease in egg production, egg weight and shell thickness as a result of high temperature (Rozenboim *et al.*, 2007). High temperature has a direct but negative association with feed intake, and the latter had been reported as having positive influence on egg production. Therefore whatever affects feed intake will automatically take its toll on egg production. In ostrich, a significant effect of month of production was found in previous studies (Ipek and Sahan, 2004; Wohr and Erhard, 2005; Elsayed, 2009). In

chickens, Malau-Aduli *et al*. (2003) also reported seasonal variation in egg production and mortality rate in a commercial laying farm, while in layer breeders, Olawumi *et al*. (2008) observed significant effect of breed on egg production, hatchability and mortality rate. While separate effects of breed and season on birds' productivity were given prominence in literature, little attention has been paid to the interaction between breed and some non-genetic factors affecting production traits of domestic chicken. This refers to ranking order of strains of chickens vis-à-vis their performance during the season or other environmental factors. According to Olawumi and Ogunlade (2010), breed by age interaction had significant effect on egg production and feed efficiency in a commercial laying flock. In addition, Akhtar *et al*. (2007) found significant effect of breed on egg production and feed efficiency among Lyallpur Silver Black, Fayoumi and Rhode Island Red birds. With regards to other economic traits especially in layer breeders, Olawumi (2007) observed significant breed x season interaction effects on egg production, fertility and hatchability rates. Egg production, as well as fertility and hatchability are reproductive traits, lowly heritable, and are affected by several factors such as strain of chicken, nutrition, mortality, health, management practices, age at point of lay and persistency of lay.

There is dearth of information in literature regarding interaction effects between strain and season on reproductive performance of commercial laying birds in the Derived Savannah zone of Nigeria. This interaction refers to the ranking order of different breeds' or strains' productivity as affected by different seasonal periods. This study therefore, compared and ranked the productivity of three strains of commercial layers at different seasonal periods.

MATERIALS AND METHODS

Three hundred birds comprising 100 layers each of Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB) were raised on deep litter at Teaching and Research Farm, Ekiti State University, Ado-Ekiti between August, 2007 and September, 2008. They were of the same age (22 weeks) at the commencement of the experiment, and fed *ad libitum* with layers mash containing 16%CP and 2650 Kcal/kgME. Medications and vitamins were given on regular basis to boost the immunity level of the birds. Data on egg production, mortality and feed efficiency of the three strains of exotic commercial layers: Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB) were used for this study. Season of production was sub-divided into four: early rain (ER: May-July), late rain (LR: August-October), early dry (ED: November-January) and late dry (LD: February-April). Commercial layers' feed were given *ad libitum* containing 16%CP and 2650Kcal/kgME from 5% production to the end (78 weeks) of the experiment. The layer mash was fortified with micronutrients and synthetic lysine and methionine in order to ensure good performance in terms of egg number and size. Water was also given *ad libitum*

Data collection

Records of egg production, feed intake and mortality for individual strain were taken on daily basis, and these were pooled together at the end of one year for the purpose of analysis and comparison among the three strains. Feed efficiency was also calculated for the three strains, and it refers to the ratio of hen-day egg production to feed (gm) consumed, that is,

$$\text{Feed efficiency (FE)} = \frac{\text{hen-day eggs/bird/week}}{\text{Feeds (gm)/bird/week}}$$

The higher the FE value, the higher the efficiency of the birds in converting feeds to eggs or meat, that is, the better the performance of the birds.

Data Analysis

Data collected were analysed using analysis of variance (ANOVA) and the differences between means of egg production, mortality and feed efficiency were separated by Duncan New Multiple Range Test (DMRT) as per SAS (2001).

The appropriate statistical model used was:

$Y_{ijk} = \mu + (GS)_{ij} +$ $_{ijk}$

Y_{ij} = observation on k^{th} population, of i^{th} genotype and j^{th} season

μ = common mean

$(GS)_{ij}$ = fixed strain x season interaction

$_{ij}$ = error term

RESULTS

Result in Table 1 represented strain by season interaction effects on egg production. There was highly significant ($P<0.01$) strain by season interaction effects on this trait. Season by season analyzes showed that IB recorded highest mean vaues and ranked first in egg production in early rain (ER), BN has intermediate mean values, while DB was the lowest . In late rain (LR), IB maintained the first position, followed by BN, and DB, the least. Dry season recorded somewhat different results as pertaining to strains' performance. BN ranked first and has the highest mean values in early dry (ED), IB recorded intermediate mean values, while DB was still in third position. And in the late dry (LD), IB ranked first again, BN took the second and DB the lowest in terms of egg production.

Table 1: Strain x season interaction effects on egg production

Season	Breed	N. (weeks)	LSQ	(±SE)
ER	IB	13	5.02	0.22^{cde}
	BN	13	4.96	0.22^{cde}
	DB	13	4.76	0.22^{de}
LR	IB	19	5.30	0.18^{abcde}
	BN	18	5.20	0.19^{bcde}
	DB	17	4.62	0.19^{e}
ED	IB	13	5.85	0.22^{ab}
	BN	13	5.92	0.22^{a}
	DB	13	5.42	0.22^{abcd}
LD	IB	13	5.52	0.22^{abc}
	BN	13	5.46	0.22^{abc}
	DB	13	5.06	0.22^{cde}

^{abcde} means along columns with different superscripts are significantly different; ER: early rain; LR: late rain; ED: early dry; LD- late dry; IB: Isa Brown; BN: Bovan Nera; DB: Dominant Black

Table 2: Strain x season interaction effects on Mortality

Season	Breed	N. (weeks)	LSQ	(±SE)
ER				
	BN	13	0.15	0.13^{ab}
	IB	13	0.00	0.13^{b}
	DB	13	0.08	0.13^{ab}
LR				
	BN	19	0.16	0.11^{ab}
	IB	18	0.39	0.11^{ab}
	DB	17	0.24	0.12^{ab}
ED				
	BN	13	0.23	0.13^{ab}
	IB	13	0.08	0.13^{ab}
	DB	13	0.46	0.13^{a}
LD				
	BN	13	0.00	0.13^{b}
	IB	13	0.00	0.13^{b}
	DB	13	0.08	0.13^{ab}

^{ab} means along columns with different superscripts are significantly different; ER: early rain; LR: late rain; ED: early dry; LD: late dry; IB: Isa Brown; BN: Bovan Nera; DB: Dominant Black

Table 3: Strain x season interaction effects on feed efficiency

Season	Breed	N. (weeks)	LSQ	(±SE)
ER				
	IB	13	0.0057	0.0003^{abc}
	BN	13	0.0056	0.0003^{bc}
	DB	13	0.0054	0.0003^{c}
LR				
	IB	19	0.0061	0.0002^{abc}
	BN	18	0.0060	0.0002^{abc}
	DB	17	0.0054	0.0002^{c}
ED				
	IB	13	0.0064	0.0003^{ab}
	BN	13	0.0066	0.0003^{a}
	DB	13	0.0060	0.0003^{abc}
LD				
	IB	13	0.0064	0.0003^{ab}
	BN	13	0.0064	0.0003^{ab}
	DB	13	0.0058	0.0003^{abc}

^{abc} means along columns with different superscripts are significantly different; ER: early rain; LR: late rain; ED: early dry; LD: late dry; IB: Isa Brown; BN: Bovan Nera; DB: Dominant Black

In the current study (Table 2), there was significant ($P<0.01$) strain by season interaction effects on mortality. The results showed that DB had the highest mean values in almost all the season subdivisions, BN was second in that order, while IB recorded the lowest in all the seasons considered.

Table 3 showed significant ($P<0.01$) strain by season interaction effects on feed efficiency. IB recorded significant higher mean values in ER, LR and ED, but took second position in ED. BN on the other hand, ranked first in ED only, and second in other seasons, while DB has the lowest mean values in feed efficiency in all seasons. This was similar to what was reported for all the strains with regard to egg production.

DISCUSSION

This study reveals that the performance of strains in terms of egg production depends on individual hen's genetic make-up, and varies with seasons between breeds or strains. This implies that egg production in commercial laying stock is breed and season dependent. Some breeds have adapted to certain environment, and thereby are good producers than others. Overall results for 56 weeks of production indicate that IB showed superiority over BN and DB in all seasonal subdivisions, that is, both wet and dry seasons. The strain ranked first, and recorded higher mean values at ED, even under high temperature when the weather conditions then were not favourable to birds' performance. During other seasons, that is, ER, LR and LD, IB genotype still recorded higher egg yield per hen per week. IB genotype was therefore, considered a good strain for commercial egg production in this agro-climatic zone. Following IB genotype closely was BN strain in terms of performance in egg production. The latter was second in ranking order, and was equally good and productive. However, DB occupies the third position in ranking order among the three strains in respect of the trait under investigation. Even though the strain was not a poor egg layers, the rate of production per hen per week was the least in comparison with the other two strains. The obtained result showed that breed's performance varies from season to season. A breed that is good in the early part of rain or dry season may perform poorly at another period of the year if it is not well adapted to that environment. The genetic constitution of different breeds of chickens is a major factor responsible for these seasonal responses, and the observed uneven or dissimilar reproductive capabilities. The result in this study was consistent with the findings of Olawumi (2007) who reported significant genotype by season interaction effects on the performance of two breeds of layer breeders. In addition, Olawumi and Ogunlade (2010) observed significant strain by age interaction effects on egg production in a commercial laying flock.

In the current study, all the three strains had higher survival rate, that is, lower mortality rate during the observed period which lasted over 56 weeks. However, IB appeared hardy and heat tolerant considering its lowest mortality rate in all seasons. In LR season, the three strains had some mortality but still very insignificantly low. DB strain recorded highest mean values in ED season though less than one dead per week throughout the period of study. And in the LD season, all the strains recorded almost zero mortality per strain per week. In ranking order, IB strain appears better and superior to other two strains in survival ability, or ability to survive in both hot and cold weather conditions. In addition, BN strain was second or intermediate in survival ability, while DB genotype could be considered as the least in that order. The result showed that survival rate in chickens was breed and season dependent. This implies that adaptability to seasonal fluctuations varies from one breed to another, and one could measure this characteristic based on the number of death per breed recorded in a particular year of production. The obtained result was in contrast to the findings of Olawumi (2007) who observed no significant genotype x season effects on mortality in layer breeders.

With regard to feed efficiency, IB strain recorded higher and superior mean values in ED, intermediate in BN, while DB genotype had the least. This implies that IB birds utilized efficiently and converted the feeds given into more eggs than the other two strains. In ER season, BN strain was superior to IB and DB genotypes in feed

efficiency, while in the LR, both BN and IB strains were at par, that is, recorded similar mean values, and better than DB strain. The obtained result in LR was the same for LD, that is, BN and IB strains were at par, but superior to DB strain in feed efficiency. As was the case with egg production, DB strain had the lowest mean values in all the seasonal subdivisions. The result indicates that IB strain ranked first in feed efficiency, and was an excellent feed converter, followed by BN and DB strain, the least.

The sustainability and profitability of any poultry enterprise depends on how efficient a breed is in terms of feed conversion either to meat or egg. The high cost of feed materials coupled with high temperature typical of tropical region tend to reduce the productivity of hens, and which in turn has negative effect on profit margin of stockholders necessitate the desire to acquire a more productive, viable and feed efficient strain of layers. It is therefore, imperative that the more efficient and viable breed be purchased which will be able to produce profitably under this stressful environment. The result in this study was consistent with the findings of Olawumi and Ogunlade (2010) who found significant strain by age interaction effects on feed efficiency and Olawumi (2011) who reported separate significant effect of breed and season on feed efficiency. Future genetic study is needed to determine the gene loci responsible for the differences observed in strains' response to environmental fluctuations. These genes of interest could then be introgressed to other strains for optimum performance.

Conclusion

The present study revealed that egg production, mortality and feed efficiency were breed and season dependent. IB genotype was better, superior and ranked first in all the traits and in all seasons considered. The strain was very productive when compared to BN and DB strains. BN strain ranked second or intermediate, while DB genotype was the least or occupied third position in all the traits and seasons evaluated. Strain of birds and conducive environment are therefore, necessary conditions for optimal productivity in any flock of commercial layers.

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