Journal of Applied and Natural Science 3 (1): 20-24 (2011)

JANS

Assessment of long-term production traits of three breeds of exotic commercial layers in the derived Savannah zone of Nigeria

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Abstract: This study was carried out to compare production traits of three breeds of exotic commercial layers for a production period of 15 months. The breeds are Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB) and the traits considered are hen-day egg production, feed efficiency and mortality rate. The general means are 5.24eggs/bird/week, 0.006/bird/week and 0.16/breed/week for egg production, feed efficiency and mortality rate, respectively. There was highly significant (P<0.01) effect of breed on egg production and feed efficiency but the reverse was the case for mortality rate. On egg production, IB genotype recorded 5.37±0.07 eggs/bird/week while BN breed had 5.41±0.08 eggs/bird/week and the values were similar but superior to DB genotype with 4.94eggs/bird/week. For feed efficiency, IB and BN breeds recorded higher mean values and were similar but superior to DB genotype. The mean values are: IB=0.006±9.05x10^{-5}, BN=0.006±8.53x10^{-5} and DB=0.005/bird/week. Breed's effect on mortality rate showed that the three genotypes had similar values, that is, breed has no significant (P>0.05) effect on this trait. There was highly significant (P<0.01) effect of age of birds on egg production. Age 2 (2nd month) recorded the highest mean values while age 14 (14th month) was the lowest. The values respectively, are 6.04±0.16 eggs/bird/week and 4.18±0.16 eggs/bird/week. In addition, there was highly significant (P<0.01) effect of age of birds on feed efficiency regardless of the breed of birds. Age 2 (2nd month) recorded the highest mean values and age 14 (14th month) the lowest. There was also highly significant (P<0.01) effect of age on mortality rate of commercial layers. The long-term production analyses showed that IB and BN genotypes are more productive, feed efficient and could be recommended to farmers as commercially viable breeds of layers.

Keywords: Breed, Trait, Egg production, Age, Mortality

INTRODUCTION

Poultry production could best be described as the sustenance of humanity as it contributes largely to societal growth and development. Animal proteins derived from meat and eggs are of high quality and its consumption is required to correct protein deficiencies among vulnerable groups. Raising of birds is an activity that can contribute to household security and income. Ponapa (1982) reported that one egg weighing 55g/day supplies 50% protein requirements of a child up to 5years of age. To reduce environmental pollution and health hazards posed by bush burning and bush meat hunting, Loibooki *et al.* (2002) suggested raising of poultry and other small domestic livestock in order to improve the ability of people to subsist on alternative sources of animal proteins. Also, illegal hunting of wildlife by communities around wildlife conservation areas such as national parks was reported by Sinclair (1995) to be having serious negative impact on migratory and non-migratory wildlife populations. Poultry production on small or large scale therefore, in addition to providing income and employment will discourage the practice of bush burning, bush meat hunting and poaching thereby reducing the heat load on the environment and consequently leads to improvement on the general wellbeing of the people. However, the success of this sub-sector depends on the genetic make-up of the breed of layers as well as the prevailing environmental factors. Fairfull (1990) reported that maternal inheritance is important for early growth rate, viability and disease resistance in chickens. Management and environment are also reported to have significant effect on birds' performance (Jayarajan, 1992). Previous researchers had reported significant effect of breed on egg production (Yakubu *et al.*, 2007, Gwaza and Egahi, 2009), mortality rate (Abdel-Rahaman, 2000, Majaro, 2001) and feed efficiency (Abdel-Rahman, 2000; Adebambo *et al.*, 2008). Feed efficiency is an economic trait and refers to the efficiency with which available feed is converted to useful products since according to Hinrich and Steinfield (2007), feed accounts for over 70% of the total cost of production. In view of the fact that birds' performance is greatly influenced by their genetic make-up and the prevailing environmental conditions, it is expedient that the different breeds of layers be assessed

Table 1. Analysis of variance for egg production, feed efficiency and mortality rate.

Sources	Traits								
	Egg production			Feed efficiency			Mortality rate		
	Df	MS	F-value	Df	MS	F-value	Df	MS	F-value
Strain	2	4.36	14.55^{xxx}	2	$6.18x10^{-6}$	15.08^{xxx}	2	0.16	0.72
Age	14	5.07	16.93^{xxx}	14	$6.42x10^{-6}$	15.66^{xxx}	14	0.33	1.46
Strain x age	27	0.26	0.87	27	$3.5x10^{-7}$	0.86	27	0.21	0.92

xxx: P<0.001

for production indices in order to rank them based on their rate of productivity and adaptability to the prevailing environmental conditions in the production zone. Breeds differ in productivity and adaptability and also perform differently in different locations due to the interaction between genotype and environment. Egg production is a quantitative trait, controlled by many pairs of genes, lowly heritable and influenced largely by the environment. Yakubu *et al.* (2007) and Majaro (2001) reported significant effect of breed on egg production while Duduyemi (2005) and Olawumi *et al.* (2008) found no significant effect of breed on egg production. There are also non-genetic sources of variation such as age (Malau-Aduli *et al.*, 2003), season (Yakubu *et al.*, 2007; Oguntunji *et al.*, 2008) and housing (Ayorinde *et al.*, 1999). On mortality rate, previous studies had revealed the significant effect of breed (Olawumi *et al.*, 2008; Yakubu *et al.*, 2007), age (Malau-Aduli *et al.*, 2003), housing (Yakubu *et al.*, 2007) and season (Olawumi, 2007) on mortality rate. Feed efficiency refers to the rate of feed conversion to either meat or egg and this also varies depending on the breed (Adebambo *et al.*, 2008), season (Oguntunji *et al.*, 2008) and age (Adebambo *et al.*, 2008) of the birds. It is pertinent to evaluate the performance of the various breeds of commercial layers on regular basis and in different agro-climatic zones in order to be able to know which of them are more productive, feed efficient and adaptable to the fluctuating local weather conditions. Also important is the determination of the age at which these breeds produce maximally when managed for a period of one year. The age factor would help the farmer to know which of the breed could produce profitably for one year in terms of egg numbers and lower mortality rate. The aim of this research therefore, was to evaluate the variations existing in egg production, feed efficiency and mortality rate amongst three strains of commercial layers commonly reared in this Derived Savannah zone and the age effect on these production traits.

MATERIALS AND METHODS

Study location: The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, University of Ado-Ekiti between August, 2007 and September, 2008. Ado-Ekiti is situated along latitude 7^031^1 and 7^049^1 North of the Equator and longitude $5^071^1$and 5^027^1East of the Greenwich meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

Management and experimental birds: The three breeds raised are Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB). One hundred (100) day-old chicks of each breed were purchased from local hatcheries and reared under the same housing and management conditions. Each breed was housed in standard, well constructed open-sided but separate pens (deep litter) from day-old till the commencement of laying. Cleanliness and other sanitary measures such as removal of caked or wet litters were carried out at regular intervals. The birds were vaccinated against Newcastle, Fowl pox and other viral diseases while antibiotics were administered on regular basis. They were dewormed and given vitamins at regular intervals. At 5% production, layers mash was introduced and given *ad libitum* containing 2650 Kcal ME/kg and 16.5% CP fortified with micronutrients. Fresh, clean water was given everyday. Debeaking was carried out at the commencement of egg production in order to reduce the incidence of egg cannibalism and pecking. The data collected lasted 58 weeks of production from 5% egg production for each breed. Daily records of eggs produced, feed consumed and mortality from 5% (23^{rd} week) production till the end of the experiment, that is, 78^{th} week were registered and used for this study. The production period was subdivided into 15 age groups at 4 weeks/age.

Feed efficiency refers to the ratio of hen-day egg production to feed (gm) consumed, that is,

Feed efficiency (FE) = hen-day eggs/bird/week / 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.

The appropriate statistical model used was:

$Y_{ijk} = \mu + B_i + A_j + [_{ijk}$

Y_{ijk} = observation of the k^{th} population, of the j^{th} age and i^{th} breed

μ= common mean

B_i= fixed effect of i^{th} breed (i=3)

A_j= fixed effect of j^{th} age (j=15)

$[_{ijk}$= random error normally and independently distributed

Table 2. Least square means showing the effect of breed on egg production, feed efficiency and mortality rate.

Factors	N (weeks)	R^2	LSQ	SE
Egg production				
IB	57	0.69	5.37	0.07^a
BN	58		5.41	0.08^a
DB	56		4.94	0.00^b
	P<0.001			
Feed efficiency				
IB	57		$6.14x10^{-3}$	$9.05x10^{-5a}$
BN	58		$6.18 x10^{-3}$	$8.53 x10^{-5a}$
DB	56		$5.62 x10^{-3}$	0.00^b
	P<0.001			
Mortality rate				
IB	57		0.14	0.07^a
BN	58		0.14	0.06^a
DB	56		0.21	0.00^b
	P>0.05			

a,b means in columns with different superscripts are significantly different, IB-Isa Brown, BN- Bovan Nera, DB- Dominant black

with zero mean and common variance.

Data analysis: The data were subjected to analysis of variance (ANOVA) and duncan new multiple range test (DMRT) to determine the differences between means of breed, feed efficiency and mortality rate using SAS (2001) computer package.

RESULTS AND DISCUSSION

Table1 shows the analysis of variance of effects affecting egg production, feed efficiency and mortality rate. Genotype and age of birds had highly significant (P<0.001) effects on egg production and feed efficiency but the reverse was the case for mortality rate. Also, there was no significant (P>0.05) strain x age interaction effect on all the traits. Table 2 shows that breed of chickens significantly (P<0.01) affected egg production and feed efficiency but the reverse was the case for mortality. In Table 3, it was indicated that age of birds had highly significant (P<0.01) effect on the three reproductive traits.

Effect of breed: The least square means showing the effect of genotype on egg production, feed efficiency and mortality rate was presented in Table 2. There was highly significant (P<0.001) effect of breed on egg production and feed efficiency but an insignificant (P>0.05) effect on mortality rate. On egg production, IB genotype recorded 5.37±0.07 eggs/bird/week while BN breed had 5.41±0.08 eggs/bird/week. The values for the two breeds were similar and superior to DB genotype with 4.94 eggs/bird/week during the observed period which lasted 58weeks for each breed. The result showed that both IB and BN birds produced at least 5eggs/bird/week and DB birds laid at least 4 eggs/bird/week regardless of their age. The result corroborates the findings of Yakubu *et al.* (2007) but contradicted that of Duduyemi (2005) who reported no significant effect (P>0.05) effect of breed on egg production. In the case of feed efficiency, IB and BN breeds recorded higher mean values and were similar but superior to DB breed. The values are: IB=0.006±$9.05x10^{-5}$, BN=0.006±$8.53x10^{-5}$ and DB=0.005/bird/week. The result confirmed previous reports (Abdel-Rahaman, 2000, Adebambo *et al*., 2008) which stated that there were significant breed differences in feed efficiency. Efficiency of feed utilization implies that for every gram of feed consumed, IB and BN breeds produced extra eggs than DB breed. This production trait has both economic and socio-climatic implications on the general wellbeing of the citizenry because the feed efficient breed will no doubt generate more returns on investment than poor feed converters. On environmental impact, DEFRA (2008) reported that a more feed efficient breed of cattle, pigs and poultry will be kinder to the environment because of lower emission of harmful gases. Furthermore, breed's effect on mortality rate showed that the three genotypes had similar values, that is, breed has no significant (P>0.05) effect on this trait. The mean values are: IB=0.14±0.07/breed/week, BN=0.14±0.06/breed/week and DB=0.21/breed/week during the observed period which lasted 58weeks of egg production per breed. The result indicates that the three breeds recorded less than 1dead/week which means that they were hardy, adaptable and heat tolerant. This result agrees with the findings of Majaro (2001) and Abdel-Rahman (2000) but in contrast to that of Olawumi *et al.* (2008) and Yakubu *et al.* (2007) who reported significant (P<0.01) effect of breed on mortality rate. The mortality rate of a flock is an important determinant in achieving success and sustainability of poultry business. It indicates the degree of resistance and hardiness of a breed of livestock. A flock with high mortality rate will cause serious economic losses and may even lead to the collapse of the business. This business failure as a result of high mortality rate

Table 3. Least square means showing the effect of age on egg production, feed efficiency and mortality rate.

Age	Egg production		Feed efficiency		Mortality rate	
	N(weeks)	LSQ(±SE)	N(weeks)	LSQ(±SE)	N(weeks)	LSQ(±SE)
1	12	5.37 ± 0.16^{bc}	12	$0.007\pm 1.8x10^{-4a}$	12	0.00 ± 0.14^{b}
2	12	6.04 ± 0.16^{a}	12	$0.007\pm 1.8x10^{-4a}$	12	0.08 ± 0.14^{b}
3	12	6.02 ± 0.16^{a}	12	$0.007\pm 1.8x10^{-4a}$	12	0.33 ± 0.14^{ab}
4	12	5.44 ± 0.16^{bc}	12	$0.006\pm 1.8x10^{-4bc}$	12	0.25 ± 0.14^{ab}
5	12	5.71 ± 0.16^{ab}	12	$0.006\pm 1.8x10^{-4ab}$	12	0.25 ± 0.14^{ab}
6	12	5.71 ± 0.16^{ab}	12	$0.007\pm 1.8x10^{-4a}$	12	0.08 ± 0.14^{b}
7	12	5.86 ± 0.16^{ab}	12	$0.007\pm 1.8x10^{-4a}$	12	0.00 ± 0.14^{b}
8	12	5.71 ± 0.16^{ab}	12	$0.007\pm 1.8x10^{-4a}$	12	0.08 ± 0.14^{b}
9	12	4.01 ± 0.16^{f}	12	$0.005\pm 1.8x10^{-4d}$	12	0.00 ± 0.14^{b}
10	12	4.91 ± 0.16^{cd}	12	$0.006\pm 1.8x10^{-4c}$	12	0.17 ± 0.14^{b}
11	12	5.13 ± 0.16^{c}	12	$0.006\pm 1.8x10^{-4bc}$	12	0.08 ± 0.14^{b}
12	12	4.95 ± 0.16^{cd}	12	$0.006\pm 1.8x10^{-4c}$	12	0.00 ± 0.14^{b}
13	12	4.58 ± 0.16^{de}	12	$0.005\pm 1.8x10^{-4cd}$	12	0.42 ± 0.14^{ab}
14	12	4.18 ± 0.16^{ef}	12	$0.005\pm 1.8x10^{-4d}$	12	0.42 ± 0.14^{ab}
15	3	4.35 ± 0.16^{ef}	3	$0.005\pm 1.8x10^{-4d}$	3	0.67 ± 0.14^{a}
		P<0.001		P<0.001		P<0.05

a,b,c,d,e and f means in columns with different superscripts are significantly different.

can be prevented if the exotic breeds being imported into the country are certified free of inherited diseases and genetic defects. When this is done and the hygiene and management practices of these birds are near ideal condition, the performance in terms of survival rate will be excellent and compare favourably with what is obtainable in their country of origin. Consequently, the protein consumption of the citizenry will be improved and increased as a result of rearing breeds of hens with good adaptability and better productivity.

Effect of age: The least square means showing the effect of age on egg production, feed efficiency and mortality rate of the three breeds regardless of the breed of birds were presented in Table 3. Firstly, there was significant (P<0.01) effect of age of birds on egg production. Age 2 (2nd month) recorded the highest mean values while age 14 (14th month) was the lowest. The values respectively, are 6.04±0.16eggs/bird/week and 4.18±0.16eggs/bird/week. It was observed that hens' productivity declined gradually from 6eggs/bird/week in the 2nd month (Age 2) to 4eggs/bird/week in the 15th month (Age 15). This result indicates that as the birds advance in age, their productivity level goes down and this corroborates the findings of Malau-Aduli *et al.* (2003) and Olawumi *et al.* (2008) who reported significant effect of age of birds on egg production. In addition, there was significant (P<0.01) effect of age of birds on feed efficiency regardless of the breed of birds. Similar to what was reported for egg production, age 2 (2nd month) recorded the highest mean values and age 14 (14th month) the lowest. The values respectively, are $0.0065\pm1.8x10^{-4}$/bird/wek and 0.0048/bird/week. This suggests that there was a positive and strong relationship between egg production and feed efficiency. The result was consistent with the findings of Adebambo *et al.* (2008) who reported that feed efficiency declines with the advancing age of birds. The obtained result also agrees with the findings of Halimer *et al.* (2007) who reported that as birds grow in age, more of the feeds are diverted to other activities such as maintenance and reproduction, thereby reducing efficiency. Furthermore, there was significant (P<0.01) effect of age on mortality rate of commercial layers. Age 15 (15th month) had the highest mean values while ages 1 (1st month), 7 (7th month), 9 (9th month) and 12 (12th month) recorded no mortality at all. There was no outbreak of any disease infection during the observed period and those that died might be due to natural causes. The result was in agreement with the findings of Malau-Aduli *et al.* (2003). The result indicates that mortality occurred mostly shortly after the commencement of egg production and at the tail end, that is, advanced age but relatively low at mid-production ages. The occurrence of prolapse at the early part of production could be responsible for the casualties recorded during the first few weeks in production while the physiological stresses associated with aging could be responsible for mortalities during the last few weeks of their production cycle. The birds' hormonal changes and physiological development at mid-cycle could be advanced as reasons why lowest mortality rate was recorded during this period.

Interaction effects: There was no significant (P>0.05) strain x age interaction effect on egg production, feed efficiency and mortality rate. This result contradicted the findings of Olawumi *et al.* (2008) who reported significant

($P<0.05$) strain x age interaction effect on egg production.

Conclusion

Both genotype and age of birds have significant ($P<0.01$) effect on egg production and feed efficiency. The evaluation of the performance of three breeds of commercial layers over a long-term period (15 months) showed that IB and BN breeds are good, productive, efficient and viable in terms of egg production, feed efficiency and mortality rate. The lower mean values reported for mortality rate also implies that the breeds are hardy and well adapted to this vegetational zone even though their production pattern showed some degrees of variability. Therefore, based on this result, any of the two genotypes can be used for commercial purposes without entertaining fears about their survival and production ability and tolerance to the prevailing hot weather.

ACKNOWLEDGEMENTS

The authors are very grateful to the staff of Teaching and Research Farm, University of Ado-Ekiti, for their support and assistance during the period of the data collection.

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