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Evaluation Of F_1 And F_2 Generations of Body Weight and Linear Body Dimensions of Normal Feathered and Plymouth Rock and Their Crossbred

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Abstract

The domestic fowl plays a major role in supplying the population with egg and meat, which are highly nutritious and popularly consumed in rural area of Nigeria. The experiment was conducted at the poultry research center (PRC) of the Faculty of Agriculture, DSUST, Ozoro, to evaluate F_1 and F_2 generations of body weight (BWT) and linear body dimensions (LBDs) of normal feathered (NF) and Plymouth Rock (PR) and their crossbred. One hundred and sixty-eight (168) sexually matured birds of NF chicken were purchased and used for the study. The NF hens were bred (natural) with PR cock. The first cross was between NF and PR cock produced (50 % Indigenous (I) and 50 % Exotic (E)) in the first filial generation (F_1). The second cross was an *inter se* mating of the heterozygous NF from the F_1 generation. The pure NF was used to produce F_1 and F_2 generations. Data attained were LBD which include: BWT (g), CL (cm) , BKL (cm), HL (cm), NL (cm), WL (cm), KL (cm), BG (cm), THL (cm), SL (cm), and TOL (cm) were subjected to statistical analysis. Results revealed that values obtained ranged from 762.75 g to 996.20 g; 1083.33 to 1333.80 g for BWT, at 12th week for F_1 and F_2 respectively. The crossbred progenies of F_1 and F_2 generations were superior in all the traits of LBD than the purebred lines. In conclusion, crossbreeding and selection should be practice to bring about genetic improvement of the crossbred lines over many generations.

Keywords: Normal feathered, crossbred, body weight, purebred, improvement, generations

Introduction

The domestic fowl plays a major role in supplying the population with egg and meat, which are highly nutritious and popularly consumed in rural area of Nigeria. The Nigeria poultry population is estimated at 140 – 160 million with about 72.4 million being the chicken population (FAO, 2006). The rural local chickens (LCs) accounts for about 80% of the total chicken population in Nigeria (Sonaiya *et al.*, 1999). Despite their economic importance and high population, Nigerian LCs has partially exploited for the purpose of genetic improvement.

Commercial production of LCs has not been effective because the stocks have been termed a 'poor producer'.(FAO, 2006). They constitute a significant contribution to human livelihood and contribute significantly to food security. Most importantly, they are known for their adaptive hardiness and superiority in terms of their

resistance to endemic diseases and other harsh environmental conditions (Malago and Baitilwake, 2009).

The Nigerian LCs are characterized by poor growth, small body size, and low egg production of 30-80 small eggs per hen per year (Akbas *et al*., 2002); Sonaiya, 2003, Adebambo *et al.*, 2006, Momoh and Nwosu, 2008 and Adedeji *et al.*, 2008). However, various researchers have revealed that under good management LC expresses the potentials of a good producer (Olawoyin, 2006; Adeolu *et al.*, 2008 and Adeleke *et al.*,2011).

NF chickens are importantly known for their adaptive hardiness and superiority in terms of their resistance to endemic diseases and other harsh environmental conditions (Momoh and Nwosu, 2008). The frequency distribution of the NF chicken was about 91.8 % while that of FF and Nn were 5.2 and 3.0 % respectively in Bayelsa State of Nigeria (Ajayi and Agaviezor, 2005). Sonaiya (1990) and Fayeye *et al*.,(2006) also reported high frequencies of the NF chicken in Nigeria.

The genetic diversity of Nigerian LCs, when compared with exotic breeds, was found to be greater and crossing of such breeds will provide opportunity for poultry breeders to develop a relatively high producing breed of chicken adapted to the rural environment of Nigeria (Sonaiya, 2002). This study was therefore to evaluate F_1 and F_2 generations of BWT and LBDs of NF pure bred lines and their crossbred performance.

Materials and Methods

The experiment was conducted at the PRC of the Faculty of Agriculture, DSUST, Ozoro. It falls within the rainforest zone of mid-western Nigeria on Latitude 5^0 32^I N and Longitude 6^0 15^I E of Greenwich meridian. The climatic condition is humid with a mean annual rainfall of between 2500 and 3000 mm. The mean temperature and RH are 27.4°C and 85 % respectively (DSUST Meteorological Station Ozoro, 2021).

Experimental Birds and their Management

One hundred and sixty-eight (168) sexually matured NF birds and six (6) PR cocks were purchased as parent stock and raised on a deep litter system. The deep litter was made of wooden material and floored with wood shavings for ease of cleaning. The house was open-sided roofed with corrugated iron sheet. It had a total of twelve (12) pens. Each pen measured 2.5 m x 1.5 m. Each pen accommodates fourteen (14) LCs. The pens were separated into two (2). Half were meted to produce the crossbred and the other halve was to maintain the pure stock. Nest boxes of 2- tier measuring 0.8 m in height and 0.8 m in length was provided in each pen. A total of twenty-four (24) hanging tubes were used as drinkers and feeders (12 drinkers and 12 feeders).

Cleaning operation was carried out daily. Disinfectants were used weekly on both feeders and drinkers to prevent contamination of micro organism. Servicing was done by keeping two (2) mature cocks in each group for natural pen mating. The birds were wing tags with Arabic numbers inscribed on them.

All groups of birds were treated and medicated similarly throughout the study period under the same management conditions. The study lasted for three (3) years. Routine preventive hygiene was encouraged by regular cleaning of the pens, drinkers and feeders. They were also dewormed and given antibiotic and vitamins. Sick birds were culled and dead birds were also removed and buried and visits to the poultry unit were kept at minimum outside the normal feeding and cleaning periods.

The birds were fed compounded breeder diets composed of (15.10 % CP and 2650 kcal ME/kg) and grower diets (16.20 % CP and 2654 kcal ME/kg). Feed and water were given *ad-libitum* throughout the experiments. Half of the NF hens were bred (natural) with PR cock. The collected eggs were tagged along sire line, incubated and hatched.

Incubation

The eggs were selected for artificial incubation by discarding very small eggs, broken shells, blood stained or dirty eggs. The eggs were

incubated and hatched at the hatchery of Winne Bounty Farms, a commercial hatchery based in Agbarho, Delta State. The incubation was done fortnightly for twelve consecutive months.

F_1 generation

After hatching, each hatch of chicks was brooded in one unit of the brooder house. Light and required heat was provided for the chicks through a 100 watts bulb. The chicks were wing- tagged and weighed individually. Glucose was administered via the drinking water. Commercial chick mash (19.5 % CP and 2800 kcal ME/kg) and fresh drinking water were given *ad libitum*. The chicks were vaccinated against Newcastle and Gumboro diseases. Coccidiostat, antibiotic and vitamins were given through their drinking water during the first month. Secondary sexual characteristics which include comb size and tail feather shape were used to sex the birds at 10 weeks of age. The BWT of chicks was recorded fortnightly up to sexual maturity (22 weeks). These birds constituted the first generation.

F_2 generation

At 8 to 12th week, (6 PR cocks and 45 NF female birds were selected based on BWT and mated *inter se* to produce the second filial generation (F_2). The males were kept together with the females. The birds were fed commercial grower's mash (16.20% CP and 2654 Kcal ME/Kg) at 6th week. Feed and fresh water were given at all time. They were vaccinated against fowl pox and Newcastle diseases. The chickens were dewormed every three months via their drinking water. Birds were sometimes stressed due to weighing and transfers, therefore vitamins were administered intermittently.

Mating Pattern

The first cross was between NF layers and PR cock produced (50 % I and 50 % E) in the first filial generation (F_1). The second cross was an *inter se* mating of the heterozygous NF birds from the F_1 generation. The second cross produced offspring that were 25 % I and 75 % E. The two crosses are schematically shown below:

Generations	**Mating Types**						
		Group 1			**Group 2**		
Parent	(100% I)	x	(100 % E)	100 **1**	x	100 **1**
F_1	(50% I: 50% E)	x ↓		100 **1**	x	↓100 **1**
F_2	(25% I: 75% E)	x ↓		100 **1**	x	100 **2**

DATA COLLECTION

Body Dimensions

Data obtained were LBD that were taken fortnightly from each bird. The LBDs include: BWT, CL, BKL, HL, NL, WL, KL, BG, THL, SL, and TOL. BWT was taken using scout 11 electronic weighing balance 600 g capacity from day - old to 20th week while 10 kg simple table scale from 20th week. LBDs were taken, using fibre tape calibrated in centimeters (cm). Feed intake (FI), and feed efficiency (FE) were also noted. Descriptions of how LBDs were taken are as follows:

CL: Length of part of the head that the comb covered.

BKL: Measured from the tip of the beak (*Rostrurn maxillae*) to the base.

HL: Measured as the distance between the base of beak and the *axis vertebrae*.

NL: This is the length of the axial skeleton from the first to the last *cervical vertebrae*.

WL: The length between the scapula and the tip (*second digits phalanges*) of the wing.

WS: The distance between the left wing tip to the right wing tip across the back of the chicken.

KL: The length of the sternum or breast plate.

BG: Circumference distance between the left scapula and the right scapula taken at the deepest region of the breast.

THL: Measured as the distance between *the hock joint* and *pelvic joint.*

SL: Measured as the distance between the mid region of the *Genus* and that of the *Regio tarsalis,*

TOL: The length between the hind region of *Regio tarsalis* and the outside of the *Digital Pedis* (mid digit).

BWT: The weight of the live bird.(Molenaar *et al.*, 2008)

Statistical analysis

Data obtained arranged into a CRD and were subjected to ANOVA using the GLM procedure of SAS (2005) to obtain mean phenotypic performance of the chickens. Significant treatment mean was separated using DMTR. The model adopted is depicted as:

Yijk = μ+ai+eijk ……..(1)

Yijk = body measurements.

μ. = overall mean

ai = effect of the ith genotype (i = 1,2,3 and 4).

eijk = random error residual error.

Results

The mean value of CL, BKL, HL and NL of NF and PR and their crossbred are presented in Table 1. Generation had significant (P<0.05) effect on all variables. The CL of F_2 crossbred had higher mean value than the parent line and F_1 crossbred. There was a significant F_2 crossbred birds generally had higher mean values for all traits. Within the F_1 and F_2, the crossbred had higher values.

Mean values for WL and WS of NF and PR and their crossbred are presented in Table 2. F_2 crossbred had significantly (P<0.01) longer WL and WS than F_1 and parent birds. The higher mean values of 24.18 cm was observed in NF x PR for F_2 crossbred for WL, while 48.45 cm was respectively obtained for WS which was also significant (P<0.05). These values was significantly (P<0.05) higher than those obtain in F_1

The mean values for KL and BG of NF and PR and their crossbred are presented in Table 3. KL and BG were significantly (P<0.05) longer in the F_2 crossbred progenies of NF x PR (16.83 cm) compared to those of pure NF (11.96 cm).The F_2 values were also higher than those of $F_{1..}$ The mean BG value of F_2 crossbreds NF x PR (14.88 cm) were higher than values reported in $F_{1.}$
The mean THL, SL and TOL of NF and PR and their crossbred are presented in Table 4. THL, SL and TOL were also significantly (P<0.05) longer in the F_2 compared to the F_1 and pure lines. The crossbred were also longer than the pure lines. Pure NF of F_1 was higher than the parent value.
Phenotypic gain in BWT of NF and PR at F_1, and F_2 generations are presented in Table 5.

The results revealed that the pure line genotypes had phenotypic increase in BWT that increased with generation. The crossbred decreased in phenotypic gain with increase in generation. They reduced from 41.29 % to 33.27 % and 41.71 % to 28.24 % for NF x PR

Discussion

The head LBDs for both parent and crossbred birds used in this study (Table 1) were observed to differ in length in favour of the crossbred progenies. The F_1 and F_2 generations were found to be superior in all the traits (CL, BKL, HL and NL respectively) than the purebred lines. These results are in agreement with the study of Msoffe *et al*., (2002) and Adeleke *et al*., (2011) carried out in Tanzania and Nigeria respectively. In general, LCs in Botswana appears to be smaller in CL, BKL, HL and NL (Badubi *et al*., 2013) than the crossbred progenies in the current study. However, the results obtained for purebred lines indicated lower performance compared to values obtained by Essien and Adeyemi (1999) and Nwagu *et al*., (2009). However, combination of genes could have contributed to such differences. The superiority of the F_2 over the F_1 and parent birds, and F_1 birds over the parent birds could be attributed to the fact that dominant gene carrier in crossbred were higher in BKL, HL and NL than

their respective recessive gene carrier in purebred of the NF chickens.

The influence of generation on WL and WS reported by Nwagu *et al*., (2009) for crossbred progenies of NF chicken was markedly higher than those obtained in this present study (Table 2). This contradiction may be due to strain and environmental differences. According to Okon *et al*., (1997), exotic breed is more superior to both purebred and crossbred progenies of chicken because the dominant gene carriers of exotic breed were higher in WL and WS than their respective recessive gene carriers in purebred lines. The observed superiorities in this current study are consistent with the reports of Adeleke *et al*., (2011).

The F_1 and F_2 crossbred of NF x PR birds were superior to the parent stock in terms of KL and BG (Table 3). This finding may be attributed to the good combining ability on these two measured traits. These traits showed rapid increase in growth and development which is in agreement with the report of Essien and Adeyemi (1999). They suggested that the effect of genotype enhanced growth and physiological development. This finding also agrees with the observation of Fayeye and Ayorinde (2006) on LCs relating to BWT and body size parameters.

The higher values observed in F_1 generation for THL, SL and TOL were however statistically significant ($p<0.05$) (Table 4). The result revealed that the genetic influence of these three traits was about the same in the parent and F_1 generation except those of F_2 generation which were higher. It could be concluded that for subsequent increase in generation these traits will proved its potential for meatiness. The present report tended to support the work of Van Marle-Koster *et al*., (2008) in native chickens that the observed traits may phenotypically improved for further crossbreeding. Similarly, Okpeku *et al*; (2003) also reported that the observed traits were higher in F_2 generation than both parent birds and F_1 generation. Kabir (2006) reported that the above measured traits of purebred birds were relatively lower than those observed in his research work of LC strains. The reasons for the differences in this present study and other related literature reports could be due to differences in strain used, experimental setting location and management system. The superiorities of the F_2 crossbred chickens to purebred lines in the traits measured are as a result of genetic influenced.
Minga *et al.*,(2004) reported on the physical characteristics of NF chicken with matured BWT of 1.18 – 1.28 kg for male and 0.9 - 1.02 kg for female with corresponding SL of 7.9 – 8.4 cm and 6.6 cm respectively. Gunlu *et al.*,(2010) observed that BWT of NF chickens generally ranged from 29.45 ± 0.29 g to 986.12 ± 21.32 g from day – old to 20th week. Okon *et al*., (1997) reported that the NF chicken has BWT of 1.97 ± 0.36 g and 1.70 ± 1.49 g for male and female. CL for male and female were 6.96 ± 1.54 cm and 3.57 ± 1.40 cm. The BKL was 3.20 ± 0.12 cm and 3.11 ± 0.03 cm for male and female. KL for male and female has 32.80 ± 2.23 cm and 27.64 ± 1.89 cm respectively. While BG information for male and female were 36.13 ± 1.85 cm and 35.57 ± 1.87 cm.

The BWT of both purebred and crossbred chickens used in this present study indicates higher performances compared to the result of Essien and Adeyemi (1999) who reported average BWT of 1.08 kg and 1.28 kg for hen and cock at 24th week, and 1.00 kg reported for Adene (2001) as average adult birds. The BWT of purebred lines in this current study was in agreement with earlier reports (Nwosu and Asuquo, 1985; Nwosu and Omeje 1985; Oluyemi and Robert, 2003 and Adebambo *et al.*, 2009) that LCs are relatively small in BWT. The present work supported the earlier submission of Shoffner *et al*., (1993) that the parent stocks with reported gene for NF were significantly smaller in the BWT when compared to crossbred progenies of both F_1 and F_2 generation. Heterosis may have accounted for the superiority. Similar observation was made by Oluyemi and Roberts (2003). They crossed local female hens and exotic broilers starter. They concluded that heterosis produced offspring that were heavier in live weight than the local parents. The increasing trends BWT of crossbred bird in this present study showed that crossbreeding could significantly improve the performance of the NF chicken for meat production.

Conclusion

The crossbred progenies of both F_1 and F_2 generations were found to be superior in all the traits of LBDs than the purebred lines. The low BWT and LBDs produced by purebred birds in this study may indicate less genetic variability relative to purebred lines. Therefore, crossbreeding and selection should be practice to bring about genetic improvement of the crossbred lines over many generations.

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Table 1: Mean (±SD) of Head Dimensions of NF and PR and their crossbred

Variable (cm)	Strain	Parent	F_1	F_2
CL	Normal feathered	4.16 ± 0.07^{b}	4.33 ± 0.03^{b}	5.02 ± 0.32^{a}
	Exotic (Plymouth Rock)	6.98 ± 0.04	-	-
	Normal X Exotic	-	5.53 ± 0.19^{b}	6.90 ± 0.20^{a}
BL	Normal feathered	3.29 ± 0.05^{c}	4.10 ± 0.06^{b}	4.92 ± 0.12^{a}
	Exotic (Plymouth Rock)	4.40 ± 0.04	-	-
	Normal X Exotic	-	6.10 ± 0.20^{b}	7.08 ± 0.10^{a}
HL	Normal feathered	5.48 ± 0.06^{c}	7.07 ± 0.03^{b}	7.90 ± 0.16^{a}
	Exotic (Plymouth Rock)	8.18 ± 0.65	-	-
	Normal X Exotic	-	8.57 ± 0.03^{a}	8.60 ± 0.11^{a}
NL	Normal feathered	6.44 ± 0.12^{c}	8.78 ± 0.09^{b}	8.92 ± 0.24^{a}
	Exotic (Plymouth Rock)	13.94 ± 0.03	-	-
	Normal X Exotic	-	12.60 ± 0.06^{b}	15.58 ± 0.26^{a}

Means with different superscript on the row are significantly different ($p < 0.05$)

Table 2: Mean (±SD) of Wing Dimensions of NF and PR and their crossbred

Variable (cm)	Strain	Parent	F_1	F_2
WL	Normal feathered	12.51 ± 0.24^{c}	15.87 ± 0.38^{b}	19.84 ± 0.45^{a}
	Exotic (Plymouth Rock)	27.45±0.03	-	-
	Normal X Exotic	-	18.37 ± 0.07^{b}	24.18 ± 0.29^{a}
WS	Normal feathered	25.12 ± 0.48^{c}	31.83 ± 0.77^{b}	39.78 ± 0.91^{a}
	Exotic (Plymouth Rock)	55.00 ± 0.06	-	-
	Normal X Exotic	-	36.83 ± 0.13^{b}	48.45 ± 0.59^{a}

Means with different superscript on a row are significantly different ($P < 0.05$)

Table 3: Mean (±SD) of Body Measurements of NF and PR and their crossbred

Variable (cm)	Strain	Parent	F_1	F_2
KL	Normal feathered	4.10 ± 0.29^{c}	6.55 ± 0.05^{b}	11.58 ± 0.36^{a}
	Exotic (Plymouth Rock)	36.87 ± 0.71	-	-
	Normal X Exotic	-	12.70 ± 0.06^{b}	16.83 ± 0.43^{a}
BG	Normal feathered	5.98 ± 0.21^{c}	8.70 ± 0.15^{b}	10.34 ± 0.39^{b}
	Exotic (Plymouth Rock)	20.91 ± 0.05	-	-
	Normal X Exotic	-	10.83 ± 0.03^{b}	14.88 ± 0.36^{a}

Means with different superscript on a row are significantly different ($p < 0.05$

Table 4: Mean (±SD) of Limb Measurements of NF and PR and their crossbred

Variable (cm)	Strain	Parent	F_1	F_2
THL	Normal feathered	11.46 ± 0.06^{c}	12.37 ± 0.03^{b}	16.92 ± 0.34^{a}
	Exotic (Plymouth Rock)	32.78±0.16	-	-
	Normal X Exotic	-	15.40 ± 0.06^{b}	20.60 ± 0.24^{a}
SL	Normal feathered	7.40 ± 0.04^{c}	8.97 ± 0.07^{b}	11.82 ± 0.28^{a}
	Exotic (Plymouth Rock)	17.27±0.47	-	-
	Normal X Exotic	-	10.10 ± 0.25^{b}	12.78 ± 0.29^{a}
TOL	Normal feathered	4.70 ± 0.03^{c}	6.77 ± 0.03^{b}	6.64 ± 0.15^{a}
	Exotic (Plymouth Rock)	9.38 ± 0.31	-	-
	Normal X Exotic	-	7.17 ± 0.07^{a}	6.98 ± 0.16^{b}

Means with different superscript on a row are significantly different ($p< 0.05$)

Table 5: Phenotypic gain in BWT of NF and PR at F_1, and F_2 generations

Genotype	P	F_1	H%	F_2	H%
Normal feathered	709.25	839.33	54.95	782.00	58.03
Exotic (Plymouth Rock)	3017.17				
Normal feathered x exotic		998.20	55.44	940.33	57.60

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