



**A Comparative Study of Growth Performance and Feed Efficiency in Dominant Black Strain, Fulani Ecotype Chicken and Progeny from their Reciprocal Crosses**

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### Abstract

A study of the relative performance of a local chicken (Fulani Ecotype or FExFE), an exotic chicken (Dominant Black or DBxDB), and their reciprocal crosses (DBxFE and FExDB) was undertaken. A total of three hundred and thirty (330) chickens comprising 100 DBxDB, 80 DBxFE, 80 FExDB and 70 FExFE were studied. All animals were raised from day old to 21 weeks age contemporaneously under identical housing, feeding and management procedures during which growth parameters were measured. Significant ( $p < 0.05$ ) differences in weight gain were observed between groups (FExDB  $1365.10 \pm 2.47$ , FExFE  $1367.00 \pm 2.98$  > DBxFE  $1346.80 \pm 3.05$  > DBxDB  $1314.40 \pm 3.61$ ) over the 21 week experimental period. FExFE had significantly ( $p < 0.05$ ) lower Feed Efficiency than all other groups (FExDB  $69.18 \pm 0.03$ , DBxDB  $68.78 \pm 0.03$ , DBxFE  $68.50 \pm 0.02$  > FExFE  $67.50 \pm 0.02$ ) over the same period. Low mortality ( $\leq 2\%$ ) occurred across genotypes with FExFE having the least mortality. The results indicated that reciprocal crossing of pure local Fulani Ecotype with exotic Dominant Black strain produces chickens with indistinguishable Feed Efficiency from the highly improved Dominant Black, and superior to the pure Fulani. Cross breeding of the type reported here may therefore serve as a tool for improving efficiency of Fulani Ecotype local poultry whilst retaining elements of their valued characteristics which include meat value. Further studies will evaluate the hybrids (F1) of FE and DB for retention of desirable characteristics of local breeds.

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### Introduction

Selection and cross breeding offer means through which genetic variation can be leveraged systematically to improve poultry productivity. The use of first filial generation (F1) cross-breeds in production agriculture particularly offers a means through which rapid improvement can be achieved in ways that combine desirable characteristics (appearance, productivity and fitness) of each of the crossed breeds, to create an animal that exhibits a more-desirable mixture of traits than is possible with either alone. Unlike the case with pure breeds, segregation which occurs during further breeding of F1 animals can markedly destroy favourable combinations of genes contributed by the original parents, thereby increasing variation within and between desirable traits, and reducing overall productivity of subsequent generations if unselected, there is therefore a need for recurrent cross-breeding to create F1 animals for production. The direct use of F1 cross-breeds in production agriculture is particularly

desirable where the economics of breeding are favourable i.e. the additional cost of production imposed by the requirement for recurrent breeding of F1 is outweighed by potential economic gain from superior productivity of the F1.

In Nigeria, Local Chicken production constitutes a significant portion of the chicken industry which is a major contributor of animal protein in the national diet (Ayorinde, 1986). Neither local, nor exotic chickens possess clear-cut superiority in the combination of productivity, adaptability, and resistance to local diseases which is desirable. The Nigerian Local Chicken (NLC) exhibits higher fertility and hatchability under natural incubation, and better adaptation to the prevailing diseases, physical conditions and local management practices than exotic chickens. In addition, its meat is perceived to have superior gustatory

qualities. It is however less productive (meat and eggs) than its exotic counterparts.

The indigenous chicken exhibit high genetic variance in their performance, and therefore have great potential for genetic improvement through cross breeding and/or selection in breeding and improvement programmes (Omeje and Nwosu, 1983; Nwosu *et al.*, 1985; Ikeobi *et al.*, 1996; Adebambo *et al.*, 1999, 2009; Peters, 2000; Adedeji *et al.*, 2008 ). Cross breeding of local chicken with exotic commercial chicken will combine the advantage of the legacy of objective systematic scientific selection for productivity in the exotic birds and subjective selection by local farmers coupled with natural selection for hardiness in the indigenous birds, to produce a chicken that has the combined advantages of both parents. It is often impossible to predict *a priori* how a hybrid between two lineages will perform in comparison with either of its parent types when assessed on a single trait or combination of traits of interest. Indeed, performance of a hybrid may also differ according to the direction of crossing. There is therefore need to cross-evaluate performance of hybrids reciprocal crosses derived from each possible direction of crossing (reciprocal crosses), and also to compare hybrids with each of the original parental types, so as to assess whether and to what extent their performance exhibits any merit beyond what is possible from either parent-type alone.

The Nigerian Fulani Ecotype (FE) chicken has been reported to have great potential for genetic improvement in growth and reproductive performance (Atteh, 1990; Tihamiyu, 1999; Olori, 1992; Fayeye *et al.*, 2005; Odetunde, 2007; Sola-Ojo and Ayorinde, 2009). Improving productivity of this chicken ecotype through cross breeding will not only yield economic benefit for the local farmer, it should also reduce overall national expenditure on importation of day old chicks and breeder stock which are costly to manage.

The present study determined, the relative performance of dual purpose (meat and egg type) Fulani Ecotype NLC, egg-type Dominant Black (DB) exotic strain, and their reciprocal crosses (first filial generation FEXDB and DBXFE), with a view to assessing whether and to what extent cross breeding can improve performance of the FE NLC, and whether there is merit in specifying the direction of crossing. Specifically, birds were assessed on performance characteristics which included growth from hatch to 21 weeks of age, and feed intake and efficiency.

## Materials and Methods

### Experimental birds and mating design

One hundred and forty three Dominant Black strain, DB (130 female and 13 male) and 99 Fulani Ecotype chicken, FE (90 females and 9 males) were mated in pens at 10:1 Female: Male ratio in the following combinations (mating types): 80 DB females and 8 DB males (DBXDB); 50 DB females and 5 FE males (DBXFE); 50 FE females and 5 DB males (FEXDB), and; 40 FE females and 4 FE males (FEXFE).

Fertile eggs collected weekly were labelled by mating group type and taken to a commercial hatchery for incubation and hatching. A total of 100 chicks (male plus female) were obtained from DBXDB, 80 from DBXFE, 80 from FEXDB and 70 from FEXFE for data collection. All the chicks obtained for each genotype were wing banded, weighed, and housed in Pens according to their genotype. All birds were fed a diet (NRC, 1994) designed for egg strains from day-old to 21 weeks of age. The birds were weighed weekly. Feed intake and body weight gain were also measured weekly. All data were subjected to statistical analysis by use of the mixed model analysis procedure of SAS (2003), and significantly different means were separated by use of the Duncans Multiple Range *post hoc* Test procedure of the same software package. The following model was used:

$$Y_{ij} = \mu_i + a_i + e_{ij}$$

Where  $Y_{ij}$  = body weight measurements

$\mu$  = overall mean

$a_i$  = effect of  $i^{\text{th}}$  genotype

$e_{ij}$  = random residual error

## Results and Discussions

The means of body weight of FE, DB, and their reciprocal crosses (DBXFE and FEXDB) from week 1 to weeks are presented in Table 1. There were significant ( $p < 0.05$ ) differences in body weight of the two pure bred parental lines (DB vs FE) from day old. The DBXDB had significantly higher body weight than FEXFE from day old to 9 weeks, and between 13 and 19 weeks, while FEXFE had higher body weight at 19 weeks, there were no significant differences in their body weight at weeks 11, 15 and 17. Body weight increased in DBXDB by 31.95%, 63.64%, 43.68%, 45.92% and 23.83%, from day old to week 1, weeks 1 to 3, 3 to 5, 5 to 7 and 7 to 9, respectively, while FEXFE bodyweight increased by 8.61%, 67.05%, 36.91%, 52.93% and 14.98% in the same successive periods. The percentage increases in bodyweight of DBXDB were higher than those of FE except from

week 1 to week 3 where FEXFE was 3.41% higher than DBXDB. The crossbreds (DBXFE, FEXDB) had significantly higher body weight than the purebred DBXDB from day old to 3 weeks, and at 21 weeks of age, were not significantly different from DBXDB in body weight at ages 5, 9, 15 and 17 weeks. At the 7th week of age there were no significant differences in body weight of DBXDB and DBXFE, and also, no significant differences existed in body weight between DBXDB and FEXDB at 19 weeks of age.

The results also indicated that the cross breeds have significantly higher body weight than the pure bred Fulani Ecotype chicken at day old and weeks, 1, 3, 5, 7, 9 and 13, while no significant differences in body weight were observed at 15 and 17. The body weight of DBXFE was significantly greater than that of FEXFE from day old to age 13 weeks, while FEXDB had significantly higher body weight than FEXFE from day old to 9, 13, 19 and 21 weeks of age. In body weight comparisons between the crossbreds, no significant differences were observed at 3, 5, 9, 13, 15 and 17 weeks of age, while significant differences existed in their body weight with DBXFE bigger at day old and weeks 1, 3, 5, 9, 11 and 19, FEXDB had significantly higher body weight than DBXFE at 21 weeks.

The growth patterns of the crossbreds and the pure bred DB were similar from day old to seven weeks of age and from 11 to 17 weeks there is no clear distinction in the growth patterns of all the four genotypes. However, the rate of growth of the crossbreds tended towards the pure bred DB than the pure bred FE (Table 1). Different rates of increase in body weight were observed in the purebreds and crossbreds at different ages. Nevertheless, the rates of increase in body weight of DBxFE and FExDB were not different at weeks 1 to 5 (Table 2). The DBxDB had a rate of growth that was not different from that of DBxFE and FExDB between weeks 1 and 3, and not different from DBxFE between weeks 5 and 11. Rates of increase in body weight of FExFE were significantly higher than those of other genotypes from weeks 3 to 7, 9 to 11, 13 to 15 and weeks 17 to 19. The higher rates of increase in body weight of FExFE relative to other genotypes examined at 13 to 15 weeks age. All the genotypes had a sharp reduction in their rate of growth from 17th to 21 weeks of age.

Growth performance of FE, DB, and their reciprocal crosses (DBXFE and FEXDB) from 0 – 21 weeks is presented in Table 3. There were significant ( $P<0.05$ ) differences in the total weight gained by the pure bred (DBXDB and FEXFE). Weight gained by the cross bred DBXFE and FEXDB were also significantly

( $P<0.05$ ) different, while the total weight gained by FEXDB was not significantly different from total weight gained by the purebred Fulani Ecotype chicken (FEXFE). Significant ( $P<0.05$ ) differences also existed in total feed intake of all the genotypes. The cross bred (DBXDB and FEXDB) had feed efficiencies that were not significantly ( $P>0.05$ ) different from that of the pure bred Dominant Black strain (Table 2). It was also noted that FEXFE consumed more feed and gained more weight during the experimental period while FEXDB had the highest feed efficiency followed by DBXDB, DBXFE and FEXFE accordingly. The results of this findings indicated that the crossbred utilize their feed efficiently like the pure bred Dominant Black strain. Mortality rate was less than 2% across the genotype and this is an indication that all the genotypes adapt favourably to the study environment.

The rate of increase in body weight of all the genotypes dropped at the onset of puberty when the chickens are approaching 21 weeks of age, this corresponds with the findings of Nwosu (1979), which stated that the rate of growth in chicken reduce at the onset of puberty. However, the body weight of the crossbred at 21 weeks of age in this study fell within the range of body weight at first egg (1.3-1.5kg) reported by Payne and Smith (1975), Oni *et al.* (1991), Olawumi and Ogunlade (2009) for most exotic egg laying strains of chicken at the stated weeks. Body weight is regarded as a function of framework or size of the animal and its condition (Phillip, 1970) and one of the main factors influencing egg size and feed intake is body size (Ayorinde and Sado, 1988). Significant difference in body weight between the crossbreds obtained is attributable to genetic factor because they have no recent history of cross breeding and were managed under the same environmental conditions and experimental procedures in the current study. These are in keeping with Ayorinde (1995) who stated that variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals. FEXFE examined in this study can be regarded as a heavier breed compared to DBxDB, and they also consumed more feed with lesser feed efficiency while the DBXDB strains are a light breed with higher feed efficiency, this corresponds with the findings of Rendel and Mapple (1986) which stated that heavy breed and large birds consume more feed, have lower feed conversion ratio, require more space and are therefore less economical during egg production, while small and light bodied hens are reported to produce small sized eggs because of the skeletal size, and have a relatively lower carcass value though they have higher feed conversion ratio.

## Conclusion

These results showcase the value of contemporaneous comparative evaluation of pure breeds and their reciprocal crosses in the determination of the value of first filial generation (F1) poultry for production agriculture. Collectively they show that chickens with superior live weight than possible in either FE or DB result from crossing of both breeds, and that the superior live weight of the FEXDB is also accomplished with superior feed efficiency over FE, and equivalent feed efficiency to the DB breed. The FEXDB cross is therefore superior to the DBXFE for efficient production of animals with superior live weight, and should be encouraged in preference.

Cross breeding of the type reported here will serve as a tool for improving efficiency of Fulani Ecotype local chickens whilst retaining elements of their prized characteristics which include meat value. Further studies will evaluate the reciprocal crosses (FEXDB and DBXFE) against the purebred FE and DB in terms of other desirable characteristic which include egg production in which DB is superior to FE, and hardiness and disease resistance in which FE is superior to DB.

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**Table 1: Means of body weight of FE and DB progenies from week 1 to 21 weeks**

Age (wks)	DBxDB	DBxFE	FEXDB	FEXFE
0	36.20±0.9 <sup>d</sup>	43.42±0.1 <sup>a</sup>	41.24±0.1 <sup>b</sup>	38.00±0.1 <sup>c</sup>
1	53.20±0.2 <sup>c</sup>	56.00±0.1 <sup>a</sup>	55.00±0.8 <sup>b</sup>	41.58±0.1 <sup>d</sup>
3	146.30±0.1 <sup>b</sup>	150.50±0.1 <sup>a</sup>	149.40±0.1 <sup>a</sup>	126.20±0.1 <sup>c</sup>
5	259.80±0.6 <sup>a</sup>	261.80±0.12 <sup>a</sup>	258.10±0.2 <sup>a</sup>	200.05±0.6 <sup>b</sup>
7	480.40±1.2 <sup>b</sup>	478.40±0.3 <sup>b</sup>	490.00±0.1 <sup>a</sup>	425.08±0.7 <sup>c</sup>
9	630.70±0.3 <sup>a</sup>	632.70±0.3 <sup>a</sup>	635.81±0.3 <sup>a</sup>	500.03±1.0 <sup>b</sup>
11	760.30±0.1 <sup>b</sup>	780.12±0.1 <sup>a</sup>	765.50±0.2 <sup>b</sup>	760.80±0.9 <sup>b</sup>
13	865.00±1.1 <sup>a</sup>	860.82±1.3 <sup>b</sup>	859.29±1.1 <sup>b</sup>	828.50±1.1 <sup>c</sup>
15	967.60±1.7	968.15.0±1.2	968.85±1.2	967.60±1.1
17	1148.70±2.8	1150.07±1.6	1147.51±0.5	1150.01±0.5
19	1289.60±4.1 <sup>b</sup>	1295.02±3.7 <sup>a</sup>	1289.00±3.7 <sup>b</sup>	1298.01±3.5 <sup>a</sup>
21	1350.60±4.5 <sup>c</sup>	1388.60±3.2 <sup>b</sup>	1408.50±3.5 <sup>a</sup>	1375.00±3.2 <sup>b</sup>

Means on the same row followed by the same superscripts were not significantly different. (P<0.05).

DBxDB =Dominant Black male and female

DBxFE = Dominant Black male and Fulani Ecotype female

FEXDB = Fulani Ecotype male and Dominant Black female

FEXFE = Fulani Ecotype male and female

**Table 2: Rate of increase in Body weight of Dominant Black and Fulani Ecotype chicken Progenies**

Age (weeks)	Genotypes			
	DBxDB	DBxFE	FEXDB	FEXFE
0-1	31.95 <sup>a</sup>	22.46 <sup>c</sup>	25.01 <sup>b</sup>	8.61 <sup>d</sup>
1-3	63.63 <sup>a</sup>	62.79 <sup>a</sup>	63.19 <sup>a</sup>	56.78 <sup>b</sup>
3-5	43.69 <sup>b</sup>	42.51 <sup>c</sup>	42.12 <sup>c</sup>	51.91 <sup>a</sup>
5-7	45.92 <sup>c</sup>	45.27 <sup>c</sup>	47.32 <sup>b</sup>	52.94 <sup>a</sup>
7-9	23.83 <sup>a</sup>	24.39 <sup>a</sup>	22.93 <sup>b</sup>	14.99 <sup>c</sup>
9-11	17.05 <sup>b</sup>	18.89 <sup>b</sup>	15.09 <sup>c</sup>	34.28 <sup>a</sup>
11-13	12.10 <sup>a</sup>	9.37 <sup>b</sup>	10.91 <sup>a</sup>	8.17 <sup>b</sup>
13-15	10.60 <sup>b</sup>	11.08 <sup>c</sup>	9.55 <sup>d</sup>	14.37 <sup>a</sup>

15-17	15.76 <sup>b</sup>	25.15 <sup>a</sup>	15.57 <sup>b</sup>	15.86 <sup>b</sup>
17-19	10.93 <sup>a</sup>	8.88 <sup>b</sup>	10.97 <sup>a</sup>	11.40 <sup>a</sup>
19-21	4.52 <sup>d</sup>	6.73 <sup>b</sup>	8.48 <sup>a</sup>	5.59 <sup>c</sup>

Means on the same row followed by different superscripts (a-d) differ significantly (p<0.05)

DBxDB =Dominant Black Male and Female

DBxFE = Dominant Black Male and Fulani Ecotype chicken Female

FExDB = Fulani Ecotype chicken Male and Dominant Black Female

FExFE = Fulani Ecotype chicken Male and Female

**Table 3: Growth performance of Dominant Black strain and Fulani Ecotype chicken cross bred from 0 – 21 weeks**

Parameters	DBXDB	DBXFE	FEXDB	FEXFE
Total weight gain				
(g/chicken)	1314.40±3.61 <sup>c</sup>	1346.80± 3.05 <sup>b</sup>	1365.10± 2.47 <sup>a</sup>	1367.00±2.98 <sup>a</sup>
Total feed intake (g /chicken)	1911.0±0.12 <sup>d</sup>	1965±0.11 <sup>c</sup>	1973±0.12 <sup>b</sup>	2025±0.18 <sup>a</sup>
Feed efficiency (%)	68.78±0.03 <sup>a</sup>	68.50±0.02 <sup>a</sup>	69.18±0.03 <sup>a</sup>	67.50±0.02 <sup>b</sup>
Mortality (%)	2±0.01	2±0.01	2±0.01	1±0.01

Means on the same row followed by different superscripts were significantly different (P<0.05).

DBXDB =Dominant Black male and female

DBXFE = Dominant Black male and Fulani Ecotype female

FEXDB = Fulani Ecotype and Dominant Black female

FEXFE = Fulani Ecotype male and female