QUANTITATIVE GENETIC EVALUATION OF GROWTH TRAITS, HETEROSIS AND RECIPROCAL EFFECTS IN THREE BREEDS OF DOMESTIC TURKEYS IN NASARAWA STATE, NIGERIA

Ogbuagu, K.P., Itodo, J.I. and Dogara, M.U.,
[1]Department of Animal Science, Federal University of Lafia, Nigeria

(*Corresponding Author: Ogbuagu, K.P. e-mail:neneobrown@gmail.com 07068063157)

ABSTRACT

The quantitative genetic effects of the growth traits of the Domestic Turkey (Meleagric gallapavo) in Lafia, Nasarawa State, North Central Nigeria was evaluated using a total of 200 day-old poults. A full diallel crossing experiment was conducted using three phenotypes of indigenous domestic turkeys with the following plumage colour: black, white and lavender (spotted). The poults used for the study were hatched from a foundation stock of 60 Turkeys comprising 15 Hens and 5 Toms for black, white and lavender phenotype. Mating ratio of 1 male: 5 females were employed. Randomized complete block design (RCBD) was also used to analyze the data with phenotypic class as a major factor and batch as block. Data obtained were subjected to analysis of variance (ANOVA). Results obtained showed that body weight (BW) and Linear body traits (body length, wing length, drumstick length, breast width, shank length, keel length and neck length) had a significant increase as age (weeks) increased for the main (direct) crossbred (black x lavender (spotted), BxS) and Lavender x Black compared with its purebred (Black x Black, (BxB), White x White (WxW) and lavender x lavender (SxS) counterparts. There were non-significant (P>0.05) differences in initial body weight of the purebred (31.04, 31.35 and 31.53g), main crossbred (34.86, 34.96, 35.06g) and reciprocal crossbreds (35.02, 35.26 and 35.68g), respectively, whereas final body weights for main crossbred (3710.25, 3732.42 and 3738.66g) and reciprocal crossbred (3791.58, 3795.72 and 3797.44g) differed significantly (P<0.05) across the weeks. There were also significant (P<0.05) differences in average daily weight gain (g/day) among the F_1 main and reciprocal crossbreds (336.67, 338.08 and 339.55g), (329.61, 338.08 and 339.55g) compared to their purebred (322.33, 323.55 and 323.38g) counterparts. The significant (P<0.05) difference observed in BW and LBM (BL, WL, BRW, DS, SL, KL and NL) values ranged from 2493.1 to 3320g, 37.50 to 40.26cm, 31.43 to 34.29cm, 28.04 to 30.96cm, 18.95 to 20.24cm, 13.05 to 15.05 cm, 13.81 to 14.06 cm and 17.05 to 17.67 cm, respectively for BW and LBMs. Positive heterosis (hybrid vigour) was observed for BW and all LBMs measured in the main (direct) (BxW, BxS, and WxS) and reciprocal crossbreds (WxB, SxB and SxW) studied, ranging from 0.12 to 0.83,11.35% to 33.64%, 0.56 to 2.70, 1.88% to 8.26%, 0.96 to 2.99, 7.51% to 30.88%, 0.48 to 1.18, 4.32% to 13.59%, 0.65 to 8.96, 1.10% to 8.96%, 0.43 to 4.05, 1.67% to 39.89%, 1.31 to 2.49, 7.76% to 14.62% and 0.50 to 2.41, 2.93% to 34.16%, respectively for BW, BL, WL, BRW, DS, SL, RL, and NL. There were positive and significant correlations in weeks 14 and 16 between the growth traits measured. It is concluded that the significance (P<0.05) differences observed for most LBMs and BW in different ages (weeks) for indicates that non-additive effects of genes could be exploited through crossbreeding of BxS, BxW and WxS genotypes to bring about genetic improvement for BW and LBMs. Thus, positive and significant phenotypic relationship between linear body parameters and body weight indicates that an improvement in one trait could lead to a concomitant improvement in others, if environmental factors are negligible.

KEYWORDS: Quantitative Genetics, Heterosis, Turkeys, Strains, Traits

1.0 INTRODUCTION

Exploitation of heterosis is a major reason for crossbreeding in farm animals (Ibe*et al*., 2005). Utilization of this phenomenon has led to the development of high quality breeds of livestock in both poultry and other farm animals. Usually characters that suffered reduction in inbred status are often restored or tend to be restored on crossing (Falconer, 1981). Commercial turkey breeders have made major improvements in growth traits of the modern turkey (Havenstein et al., 2004). Genetic gains could be due to improvement within the primary breeding lines (additive genetic variation) or exploited through heterosis (non-additive genetic variation) in the crosses used to produce the commercial turkeys.Heterosis has been exploited to genetically improve characters that are subject to little additive gene action, such as those related to fitness (Ndjon and Nwakalor, 1999). Crossbreeding, therefore, is one of the sure ways of achieving rapid genetic improvement in non-descript and unselected indigenous stocks within the shortest time (Jagdish, 2007). However, under experimental and field breeding conditions, not every crossbreeding effort produces desirable results. It is therefore important that an animal breeder knows what mating method to employ and what breeding goals to accomplish (Dickerson, 1992). Research on the Quantitative Genetic Evaluation of the Linear and Egg Traits of three strains of Domestic Turkeys in Nasarawa State of Nigeria is also sparse, especially concerning the use of artificial insemination in turkeys, crossbreeding of main and reciprocal cross to produce the F1 progeny to ensure positive heterosis in linear and egg traits. Therefore, addressing this gap is very crucial in improving the genetic makeup of these strains/breeds of turkeys, thereby improving their productivity and largely contributing to the economic development of Nigeria's poultry sector and generally improving rate of animal protein consumption.

Turkey is not common among poultry growers in Nigeria. However, some farms are beginning to rear the bird at commercial level owing to increasing interest in turkey as a provider of meat complementing chicken. The rate of demand of chicken eggs is high and the production of chicken eggs is low and unable to serve the high demands. The need to diversify and improve the production of turkey meats and eggs as an alternative supply is necessary since is protein content is almost equal to that of chicken. The fast growth in the industry requires an intensive research approach to boast its production especially considering the potentials associated with it. Improvement in economic characters of local turkeys can be achieved by incorporating the local turkey into breeding programmes aimed at producing an indigenous meat and egg type breed adapted to the tropical environment with a heterozygous advantage. The Breeding programmesinvolve crossbreeding of various genotypes/strains of turkey to improve the already existing breeds hence leading to generation of subsequent progenies with hybrid vigour (positive heterosis) which is the major reason for crossbreeding in farm animals.

2.0 MATERIALS AND METHODS

2.1 Location of the study

This study was conducted at the Zara Farms Ltd,,Lafia, Nassarawa State. The farm is in Bukansidi Lafia in the Southern Guinea Savannah Zone of Nigeria on Latitude 8028! 7.78N and longitude 8033! 31.11E. The average minimum temperature is 230C and maximum temperature is 36.90C mean monthly relative humidity is 74%. The mean annual rainfall is 823mm; the mean monthly temperature is 35.060C (NIMET, 2019).

2.2 Sources of Experimental Animals

The experimental poultry birds were purchased from Akwanga Market and Shinge Market in Nasarawa State.

2.3 Experimental Animal Management

Adult local turkeys of three phenotypic classes based on colour (Black, White and Lavender) was used as a parental population to generate the F1 poults for the study. They were brooded differently according to phenotypic group (Black, White and Lavender) from day-old to 6 weeks in a battery cage system after which were transferred to deep litter pen at 6 weeks of age and reared till week 28. Dry wood shavings will be used as litter material. Routine management operations such as washing of the water and feed troughs were carried out on daily basis. Prophylactic antibiotics and anticoccidial drugs was administered to the birds every month for six months. The birds were also dewormed. Feeds were provided in adequate quantities to the poults twice daily (morning and evening) and drinking water ad libitum. Poults (0-6weeks) were fed starter mash containing 28% crude protein and 2800 kcal ME/kg (as labeled). Growing turkeys (7-20 weeks) were fed growers mash containing 20% crude protein and 3000 kcal ME/kg (as labeled). Laying hens (21-30 weeks) were fed layers mash containing 18% crude protein and 3200kcal ME/kg (as labeled) at 5% egg production. All feeds used were commercial feed (Top feed). At 16 weeks of age, sexing was done by observing the development of wattles on the males. The males were transferred to different pens for mating and crossing with other phenotypic groups. Massage method was be used for collection of semen from the mature selected males at the farm during the mid-day hours of 12-1pm and artificially inseminated on the hens. Eggs produced by the base population turkeys will be collected on a daily basis and identified properly with markers, and incubated for 28 days in sets. The incubator to be used will have an approximate relative humidity of 80%, temperature of 550C and proper ventilation.

2.4 Tools of Analysis

The experiment was designed as a Randomized Complete Block Design (RCBD) with phenotypic class as factor of interest and batch as block and data analyzed by analysis of variance (ANOVA) to test the null hypothesis among the various phenotypic groups (the crosses) with respect to all the linear body measurement and egg traits measured using SPSS (2020) analytical package.

Significantly different means were considered and separated using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

4.1 RESULTS AND DISCUSSION

3.1 The growth performance of the progeny of the nine mating groups (purebred, main crossbred and

reciprocal crossbred

The growth performance of the progeny of the nine mating groups (purebred, main crossbred and reciprocal crossbred) is shown in Table 1.

There were no significant (P>0.05) differences in all the progenies of the purebred, main crossbred and reciprocal crossbreds at day old (initial body weight). In the final body weight, there were no significant (P>0.05) differences in the reciprocal crossbred and main crossbred, although they were significantly (P<0.05) higher than their purebred counterparts. The result obtained in this study shows improvement in body weights and daily weight gain of purebred and crossbred progenies. It is comparable with the findings of Amao *et al.* (2015) who reported significant (P<0.05) increase in daily weight gain and body weights for main and reciprocal crossbreds than its purebred counterparts.

Nwachukwu *et al*. (2005; 2006) also reported a significant (P<0.05) increase in weight gain for main and reciprocal crossbreds than its purebred counterpart. Improved genetic potential for growth was evident in the F_1 progeny (main and reciprocal crossbred) more than its purebred counterpart. This increase in weight observed in the progenies as they approach sexual maturity is in line with the findings of Peters *et al.* (2007) who reported consistent increase in body weight as age increased

Table 1.Growth performance of F_1turkeys (Purebred, Main Crossbred and Reciprocal crossbred).

Parameters	Purebred BxB	WxW	SxS	Main crossbred BxS	BxW	WxS	Reciprocal crossbred WxB	SxW	SxB
Initial body weight (g)	31.04 (3.18)	31.35 (3.86)	31.53 (3.92)	34.86 (3.41)	34.96 (3.45)	35.06 (3.48)	35.02 (3.47)	35.26 (3.55)	35.68 (3.59)
Final body weight (g)	2813.30[b] (26.15)	2826.84[b] (27.66)	2829.55[b] (27.83)	3710.25[a] (33.80)	3732.42[a] (34.57)	3738.66[a] (35.11)	3791.58[a] (32.61)	3795.72[a] (32.87)	3797.44[a] (33.21)
Average daily weight gain (g/day)	322.33[c] (8.03)	323.55[c] (8.27)	323.38[c] (8.45)	329.61[b] (8.13)	330.33[b] (8.29)	327.33[b] (8.44)	336.67[a] (8.41)	338.08[a] (8.53)	339.55[a] (8.67)

[a-c]means in the same row with different superscripts are significantly different (P<0.05).*S.E.M in Parenthesis,Purebred= BxB = Black x Black, WxW = White x White and SxS = Lavender x Lavender, Main crossbred= BxS = Black x Lavender, BxW = Black x White and WxS = White x Lavender, Reciprocal crossbred= WxB = White x Black, SxW = Lavender x Lavender, SxB = Lavender x Black.

3.2 Least squares means and standard errors of F_1 crosses for body weight and linear body measurements at week 20.

Table 2 presents Least squares means and standard errors of F_1 crosses for body weight and linear body measurements at week 20.

In week 20, there was significant (P<0.05) difference in BW, which was highest for SxB, SxW, BxW, BxS, WxB and WxS and moderate for BxB, WxW and SxS with values ranging from 2493.1 to 3320. There was significant (P<0.05) difference in BL, which was highest for both main (direct) and reciprocal crossbreds with the values ranging from 37.50 to 40.26. The purebreds (BxB, SxS and WxW) also had moderate significant (P<0.05) difference in body length. There were significant (P<0.05) differences among the main and reciprocal crossbreds for WL, BRW, DS, SL, KL and NL. The values ranged from 31.43 to 34.29, 28.04 to 30.96, 18.95 to 20.24, 13.05 to 15.05, 13.81 to 14.06 and 17.05 to 17.67) respectively.

This significant increase in the body weights of the mating groups (purebred, main (direct) and reciprocal crossbreds) suggests that the turkeys have potentials for fast growth as age increased. This observation is in line with reports of Amao *et al.* (2015) who reported an increase in body weights as age increased in a crossbreeding experiment involving Nigerian indigenous turkey breeds and their exotic counterpart's increases as their age increase. This increase in body weight could also probably be due to high genetic potentials for growth in the turkey genotypes as they attain sexual maturity age (Peters *et al*., 2007). Nestor *et al.* (2001 and 2005) reported a significant increase in BW and some linear body traits at 8, 16 and 20 weeks of age in a diallel crosses breeding between a commercial sire line and F line turkeys. Ibe *et al.* (2005) reported significant increase in BW and LBMs as result of crossbreeding (positive heterosis) effect involving a diallel crosses of New Zealand white; Dutch Chinchilla rabbit. Similarly Okoro *et al*. (2012) also reported significant increase in BW and linear body traits in three genotypes of locally adapted turkeys: black, bronze and white. Nwachukwu *et al.* (2005; 2006) also reported a significant increase in BW gain for man and reciprocal crossbreds in indigenous chicken. Ilori *et al*. (2011) and Olowofeso (2009) also observed similar increase in linear body traits as ages increase in poultry. Consequently Gous (1999) stated that an increase in linear body traits indicates growth of the turkeys and such growth rate is normally accompanied by an orderly sequence of maturational changes and involves accretion of protein and increase in length.

Table 2: Least square means and standard error of F_1 poults for body weight and linear body measurements at week 20

Genetic Group	BW	BL(cm)	WL (cm)	BRW (cm)	DS (cm)	SL (cm)	KL (cm)	NL (cm)
BxB	2503^{bc}	37.56^{bc}	31.47^{bc}	28.05^{bc}	28.05^{bc}	18.97^{bc}	13.82^{bc}	17.06^{bc}
	± 8.12	± 0.18	± 0.06	± 0.17	± 0.12	± 0.03	± 0.04	± 0.12
BxW	3262^{ab}	39.32^{abc}	32.24^{abc}	30.15^{ab}	19.99^{ab}	14.69^{ab}	13.99^{ab}	17.59^{ab}
	± 0.13	± 0.21	± 0.05	± 0.19	± 0.34	±0.05	± 0.05	± 0.43
BxS	3260^{ab}	39.22^{abc}	32.23^{bc}	30.14^{ab}	19.98^{ab}	14.67^{ab}	13.98^{ab}	17.58^{ab}
	± 0.12	± 0.33	± 0.03	± 0.24	± 0.05	± 0.11	± 0.08	± 0.22
WxW	2493.1^{bc}	37.50^{c}	31.43^{ab}	28.04^{bc}	18.95^{bc}	13.05^{bc}	13.81^{bc}	17.05^{bc}
	± 0.16	± 0.19	± 0.13	± 0.08	± 0.42	± 0.18	± 0.14	± 0.15
WxB	3312^{ab}	40.21^{ab}	34.27^{ab}	30.93^{a}	20.21^{a}	15.04^{a}	14.03^{a}	17.65^{a}
	± 0.12	± 0.42	± 0.32	± 0.37	± 0.28	± 0.08	± 0.13	± 0.13
WxS	3263^{ab}	39.34^{abc}	34.25^{ab}	30.16^{ab}	20.18^{ab}	14.71^{ab}	13.96^{ab}	17.60^{ab}
	± 0.15	± 0.16	± 0.06	± 0.08	± 0.32	± 0.03	± 0.18	± 0.44
SxS	2497^{c}	37.54^{bc}	31.45^{ab}	28.07^{bc}	18.99^{bc}	13.08^{bc}	13.84^{bc}	17.08^{bc}
	± 0.17	± 0.22	± 0.03	± 0.07	± 0.41	± 0.13	± 0.06	± 0.17
SxB	3320^{a}	40.23^{bc}	34.29^{a}	30.96^{a}	20.22^{a}	15.03^{a}	14.06^{a}	17.67^{a}
	± 1.23	± 0.22	± 0.06	± 0.16	± 0.08	± 0.18	± 0.05	± 0.15
SxW	3317^{ab}	40.26^{a}	34.28^{a}	30.95^{a}	20.22^{a}	15.03^{a}	14.05^{a}	17.66^{a}
	± 1.30	± 0.13	± 0.05	± 0.04	± 0.19	± 0.05	± 0.131	± 0.26

a – c means in same column with different superscripts are significantly different (P< 0.05). *Purebred= BxB = Black x Black, WxW = White x White and SxS = Lavender x Lavender, Main crossbred= BxS = Black x Lavender, BxW = Black x White and WxS = White x Lavender, Reciprocal crossbred= WxB = White x Black, SxW = Lavender x Lavender, SxB = Lavender x Black.

3.3 Body weight (g) of the F_1 Local Turkeys (purebred, main and reciprocal crossbred) at different ages

Table 3 Shows Body weight (g) of the F_1 Local Turkeys (purebred, main and reciprocal crossbred) at different ages.

There were no significant (P>0.05) differences in weeks 2, 4 and 6 among the purebred, main crossbred and reciprocal crossbred. However, significant (P<0.05) differences were observed from week 8 to 24 with the reciprocal crossbred and main crossbred having better performance than their purebred counterparts. However, the reciprocal crossbred progeny had significantly (P<0.05) higher body weight than the main crossbred in weeks 8, 12, 14, 18, 20, 22 and 24. The main crossbred were significantly (P<0.05) higher in body weight than the reciprocal crossbred only in week 10. There was no significant difference (P>0.05) between the two in week 16.

The significant increase in the mean body weight of crossbred turkey phenotypes suggests that the crossbreds may have potentials for fast growth. This result is similar to the findings of Amao*et al.* (2015) who reported a significant increase in body weights as age increase in main and reciprocal crossbreds of Nigerian Indigenous turkey breeds and their exotic counterparts. This increase in body weight as age increased was probably due to high genetic potentials for growth in the F_1 progeny as they attain sexual maturity age (Ibe, 1993; Peters *et al.*, 2007)

Table 3: Body weight (g) of the F_1 Local Turkeys (purebred, mainand reciprocal crossbred) at different ages

Weeks	Purebred			Main Crossbred			Reciprocal Crossbred		
	WxW	BxB	SxS	BxS	BxW	WxS	WxB	SxW	SxB
2	440 (1.23)	441 (1.24)	442 (1.25)	450 (2.62)	452 (2.63)	451 (2.65)	453 (2.73)	455 (2.73)	454 (2.71)
4	620 (2.71)	623 (2.73)	622 (2.74)	660 (26.98)	662 (27.27)	663 (28.56)	664 (27.55)	667 (27.83)	665 (27.61)
6	880 (37.71)	879 (36.55)	881 (38.46)	885 (39.26)	886 (40.74)	888 (41.51)	884 (40.32)	885 (40.65)	886 (40.69)
8	1080^{c} (40.22)	1082^{c} (40.24)	1083^{c} (40.25)	1206^{b} (61.33)	1208^{b} (61.64)	1210^{b} (62.48)	1215^{a} (61.88)	1218^{a} (62.51)	1217^{a} (61.93)
10	1208^{c} (61.84)	1211^{c} (62.33)	1209^{c} (61.87)	1515^{a} (51.66)	1518^{a} (52.71)	1522^{a} (53.78)	1488^{b} (68.00)	1490^{b} (68.26)	1486^{b} (67.66)
12	1514^{c} (55.80)	1517^{c} (57.56)	1516^{c} (56.34)	1881^{b} (65.18)	1883^{b} (66.35)	1886^{b} (66.73)	1893^{a} (65.23)	1895^{a} (65.51)	1897^{a} (65.66)
14	1720^{c} (71.00)	1718^{c} (70.89)	1722^{c} (71.50)	2159^{b} (75.03)	2161^{b} (76.81)	2164^{b} (77.08)	2204^{a} (76.05)	2206^{a} (76.49)	2209^{a} (76.83)
16	1965^{b} (69.31)	1966^{b} (70.47)	1968^{b} (70.55)	2630^{a} (79.33)	2632^{a} (82.71)	2638^{a} (83.46)	2651^{a} (78.45)	2653^{a} (78.63)	2656^{a} (78.81)
18	2358^{c} (81.03)	2361^{c} (82.66)	2355^{c} (80.73)	2960^{a} (83.17)	2963^{a} (85.40)	2966^{a} (86.67)	2983^{b} (85.44)	2986^{b} (85.63)	2990^{b} (87.12)
20	2493^{c} (84.45)	2503^{c} (87.03)	2497^{c} (84.86)	3260^{b} (86.05)	3262^{b} (87.57)	3263^{b} (87.68)	3312^{a} (86.78)	3317^{a} (86.94)	3320^{a} (88.05)
22	2755^{c} (85.41)	2753^{c} (84.87)	2765^{c} (86.16)	3510^{b} (89.03)	3512^{b} (90.57)	3514^{b} (91.68)	3528^{a} (89.32)	3531^{a} (90.52)	3534^{a} (91.64)
24	3018^{c} (83.38)	3028^{c} (84.93)	3016^{c} (83.15)	3630^{b} (91.84)	3633^{b} (92.56)	3637^{b} (93.65)	3750^{a} (92.93)	3752^{a} (94.93)	3754^{a} (95.93)

$^{a-c}$ means in the same row with different superscripts are significantly different ($P<0.05$).

*S.E.M in Parenthesis, Purebred= BxB = Black x Black, WxW = White x White and SxS = Lave nder x Lavender, Main crossbred= BxS = Black x Lavender, BxW = Black x White and WxS = White x Lavender, Reciprocal crossbred= WxB = White x Black, SxW = Lavender x Lavender, SxB = Lavender x Black.

3.4 Phenotypic correlations of growth traits of Main crossbred F_1 progeny

Table 4 shows phenotypic correlations of growth traits of Main crossbred F_1 progeny.

There were positive and significant correlations in both weeks 14 and 16 among the growth traits measured. Okon*et al*. (1996) reported significant (P<0.001) positive correlations between body weight and some linear body measurements (BL, BG, KL, SL and DS) in three strains of local turkey. Ali *et al*. (2003) similarly, reported significant (P<0.05, 0.01) positive phenotypic correlations between body weight and linear body measurements at various ages in their study which is also in line with results obtained in this study.

Ojedapo and Amao (2015) reported significant (P<0.05) positive correlations between body weight and body length, breast girth and drumstick with correlation values of 0.69-0.93 in their study with Exotic turkey. The results of these studies above is in line with the positive correlation findings obtained in this present study although different breeds of turkeys where used.This implies that positive and significant phenotypic relationships between linear body parameters and body weight indicates that an improvement in one trait could lead to a concomitant improvement in the other, if environmental factors are negligible.

Table 4: Phenotypic correlations of growth traits of Main crossbred F_1progeny

	BW	BL	WL	BRW	DS	SL	KL	NL
WK 14								
BW	1							
BL	0.879**	1						
WL	0.733**	0.728**	1					
BRW	0.850**	0.912**	0.758**	1				
DS	0.739**	0.945**	0.711	0.901**	1			
SL	0.853**	0.937	0.687**	0.841**	0.737**	1		
KL	0.913**	0.664**	0.647**	0.358*	0.950**	0.532*	1	
NL	0.811**	0.953**	0.703**	0.932**	0.577*	0.951**	0.841**	1
WK 16								
BW	1							
BL	0.819**	1						
WL	0.653**	0.669**	1					
BRW	0.811**	0.942**	0.763**	1				
DS	0.901**	0.932**	0.779**	0.921**	1			
SL	0.840**	0.789**	0.601**	0.831**	0.792**	1		
KL	0.884**	0.847**	0.763**	0.368*	0.968**	0.678*	1	
NL	0.817**	0.935**	0.717**	0.942**	0.633*	0.774**	0.893**	1

*= correlation is significant at the 0.05 level i.e P<0.05; **=P<0.01), BW= body weight, SL = shank length, NL = neck length, BRW = Breast width, BL = body length, KL = keel length, WL = wing length and DS = drum stick, Main crossbred = BxW, BxS and WxS.

3.5 Phenotypic Correlations of Growth traits of F_1 Reciprocal Crossbred

Table 5 shows phenotypic correlations of growth traits of F_1 Reciprocal crossbred

There were positive and significant correlations in both weeks 14 and 16 among the growth traits measured. The results obtained in these study are similar to the findings of Oyegunle *et al.* (2008) who reported significant (P<0.001) positive correlations in local, crossbreed and Exotic turkeys between pairs body weight and linear body traits with values ranging from 0.27 to 0.48. Ojedapo and Amao (2015) also reported significant (P<0.05) positive correlations between body weight and body length, breast girth and drumstick with high correlation values of 0.69-0.93. Ali *et al*. (2003) and Oyetade (2011) also reported significant (P<0.05, 0.01) positive phenotypic correlations between body weight and linear body measurements at various ages in their study which is also in line with results obtained in this study.

Thus, positive and significant phenotypic relationships between linear body parameters and body weight indicate that an improvement in one trait could lead to a concomitant improvement in the other, if environmental factors are negligible.

Table 5: Phenotypic correlations of growth traits of F_1 Reciprocal crossbred

	BW	BL	WL	BRW	DS	SL	KL	NL
WK 14								
BW	1							
BL	0.669**	1						
WL	0.598*	0.826**	1					
BRW	0.781**	0.853**	0.650**	1				
DS	0.944**	0.960**	0.511**	0.783**	1			
SL	0.688**	0.763**	0.987**	0.669**	0.874**	1		
KL	0.943**	0.445*	0.588**	0.844**	0.678**	0.633**	1	
NL	0.980**	0.870**	0.677**	0.911**	0.711**	0.888**	0.787**	1
WK 16								
BW	1							
BL	0.843**	1						
WL	0.496**	0.694**	1					
BRW	0.742**	0.934**	0.798**	1				
DS	0.967**	0.911**	0.789**	0.941**	1			
SL	0.876**	0.832**	0.733**	0.755**	0.792**	1		
KL	0.631**	0.886**	0.654**	0.452*	0.947**	0.502*	1	
NL	0.777**	0.930**	0.901**	0.879**	0.671**	0.632**	0.658**	1

*= correlation is significant at the 0.05 level i.e P<0.05; **=P<0.01), BW= body weight, SL = shank length, NL = neck length, BRW = Breast width, BL = body length, KL = keel length, WL = wing length and DS = drum stick, Reciprocal crossbred = WxB, SxB and SxW.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Body weight and linear body measurements showed significant improvement on the main (Direct) and reciprocal crossbreds from week 2 to week 24, indicating the importance of crossbreeding in domestic turkey. Thus, the linear body traits (body length, wing length, drumstick length, neck length, breast width, shank length and keel length) showed an increase as age increased with the main and reciprocal crossbreds having best performance compared to their purebred counter parts. Interactions between batch and phenotype effects were not significant in all ages for both main (direct) and reciprocal crossbreds.

Positive heterosis (hybrid vigour) was observed for BW and all the LBMs in both main (direct) (BxW, BxS and WxS) and reciprocal crossbreds (WxB, SxB and SxW) studied. This indicates that non additive effects of genes could be exploited through crossbreeding of BxS, BxW and WxS phenotypes to bring about genetic improvement for BW and LBMs. Reciprocal effect was not significant for BW and all LBMs. This suggests that any of the breeds may be used as sire or dam in planned crossbreeding programmes.

There was a positive and significant correlation in both weeks 14 and 16 among the growth traits measured. Thus, positive and significant phenotypic relationships between linear body parameters and body weight indicates that an improvement in on trait could lead to a concomitant improvement in the other, if environmental factors are negligible

4.2 Recommendations.

It is recommended that all the growth traits that were significantly correlated should be given priority in selection due to their positive heterosis exhibited and its high tendency of influencing body weight of the strains. Further studies can be carried out on the F_1 and F_2 progenies to continue improving the domestic breeds.

4.3 Acknowledgement

The Authors appreciates the Vice Chancellor and entire the Management of Federal University of Lafia and **TETFUND** for approving our application and sponsoring this Institution Based Research Work

REFERENCES

Amao, O. J., Ayorinde, K. L. and Fayeye, T. R. (2015).Body mass index and heterosis of body weight and morphometric traits of pure and crossbred turkey poults.Journal of Animal Producion Resources. (27):1-8.

Dickerson, G.E. (1992). Manual for evaluating breeds and crosses of domestic animals.Publication DIV, FAO, Rome, Italy.

Duncan, D.B. (1955). Multiple Range and Multiple F-tests Biometrics 11:1-42.

Emmerson, O.N., Iyanda, A. M. and Ozowa,W. O., (1991). Breed and heterotic effect on exotic and crossbred turkeys. Journal of Animal Science 1(3): 7-14.

Fairfull, R. W. (1990). Heterosis. In: Poultry Breeding and Genetics. R.D. Crawford, ed. Elsevier, Amsterdam, the Netherlands, pp: 913-933.

Falconer, F.N. (1981). Estimation of crossbreeding effect and Variance component due to direct and maternal effects for growth traits of 3 turkey strains. In: Proceedings of the 5th World Congress on Genetics Applied to Livestock Production, 17: 229-232.

Havenstein G.B., Ferket, P.R., Grimes, J.L., Qureshi, M.A and Nestor, K.E. (2004). Performance of 1996 vs 2003 turkeys when fed representative 1996 and 2003 turkey diets. In: Proceedings of the World's Poultry Congress, Istanbul.

Ibe, S.N. (1998). An Introduction to Genetics and Animal Breeding.Longman Nig. Plc. Lagos.Pp. 92-93.

Ilori, B. M., Akano, K., Aruleba, D. D., Isidahomen, C. E. S., Iyanda, A. M., Ozoje ,M. O., Peter, S. O. and Whato, M. (2009). Heat tolerance traits among pure and crossbred turkeys in South-West Nigeria.Proceedings of 14th Annual Conference of Animal Science Association of Nigeria. Sept. 14 – 17. Ogbomosho pp 89 – 92.

Jagdish, J.J (2007). Effect of crossbreeding on the muscle quality (chemical composition) in Un-Ling black Saudi chicken.Poultry.Science.19, 491- 507.

Ndjon, M.N. and Nwakalor, L.N. (1999). Heterosis in maternal traits from crossing of exotic and local breeds of rabbits. Tropical Journal of Animal Science 1 (2): 9-15.

Nestor, K.E., Anderson, J.W. and Patterson (2000).Genetics of growth and reproduction in the turkey. 14. Changes in genetic parameters over thirty generations of selection for increased body weight. Poultry Science 79: 445-452.

Nestor, K.E. Anderson, J.W. and Velleman, S.G. (2005). Genetic variation in pure lines and crosses of large-bodied turkey lines. 3. Growth-related measurements on live birds. *Poultry Science* 84:1341-1346.

Nwachukwu, E.N., Ibe, S.N. and Onyeocha, K.C. (2005). Growth performance of F_1 crosses of normal local, naked neck and frizzle chicken x Arbor Acre broilers breeder stock in a humid tropical environment. Proc. 30th Ann. Con. Genet. Soc. of Nigeria.

Nwachukwu, E.N., Ibe, S.N. and Ejekwu, K (2006). Short term egg production and egg quality characteristics of main and reciprocal crossbred normal local naked and frizzled x exotic broiler stock in humid tropical environment. *Journal Animal and Veterinary Advantage.* 5(7): 547-551.

Nwenya, J.M.I., Nwakpu E.P., Nwose, R.N. and Ogbuagu, K.P. (2017). Performance and Heterosis of Indigenous Chicken Crossbreed (Naked Neck x Frizzled Feather) in the Humid Tropics. *Journal of Poultry Research* 14(2): 7-11.

Nwakpu, P. E., Odo, B. T., Omoje, S. L., Akpa, M. and Edoga, C. C. (1999). Hatching performance of three strains of layer–type chickens and their lines. Proceedings of the 26th Annual Conference, Nigerian Society of Animal Production, 21 – 26 March, 1999. Ilorin.

Obasi, V.N. and Ibe, S.N. (2008). Influence of additive and non-additive gene effects on body measurement in the domestic rabbit *Nigeria Journal Animal Production*. 35 (1): 1-8.

Ojedapo, L.O. and Amao, S.R. (2015).Genetic Variation and Phenotypic Correlations of anExotic Turkey Reared in Savanna Region of Nigeria. International Journal of Agriculture Innovations and Research Vol. 4 (2), 376-380.

Okoro, V.M.O., Ogundu, U.E. Kadurumba, O., Iloeje, M.U., Okoro, C.L., Nosike, R.J. and Ibe, S.N. (2012). Genetic variations in locally adapted turkeys. 1. Additive and nonadditive genetic effects on growth traits. *Genomics and Quantitative Genetics* 4: 1-7.

Omole, A.J., Fapohunda, J.B.J., Osayomi, J.B and Ajayi, F.T. (2006). Back to Agric. Series (4): small and medium scale turkey farming Ibadan: Green choice Agric. Publication.

Roberson, D.C., Sarica, M., Ocak, N., Karagay, N., Yamak, U., Kop, C. and Altom, A. (2003). Growth, crossbreeding effect on sire and maternal effectinfluence of three turkey genotypes under barn and free-range housing systems. British Poultry Science, 50: 487–494.

SPSS (2010). Statistical Package for Social Sciences.SPSS Inc. 13.0 for Windows.