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Effect of Breed of Sire on Growth Performance of Exotic Crossbred Pigs in a Humid Tropical Environment

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Abstract: The study investigated the effect of breed of sire on growth characteristics of exotic crossbred pigs in a humid tropical environment. Body weight and other body traits, namely Body Length (BL), Height at Withers (HTW), Heart Girth (HG) and Rear Girth (RG) were measured biweekly for three months (12 weeks) on 96 crossbred progeny of twelve Large White (LW) sows mated with three different breeds of sire, namely Large White, Hampshire (HS) and Duroc (DC) in the ration of 1:4. The data were subjected to Analysis of Variance appropriate for Completely Randomized Design (C.R.D.) and significant means were separated with Duncan's New Multiple Range Test (DNMRT). There were significant ($p<0.05$) differences among the breeds of sire for BW, HG and RG at different ages. HS- sired progeny were superior to the progeny of the other breeds for most of the traits measured post weaning. The analysis shows that during pre-weaning phase, HS-sired progeny were superior in 48%, LW-sired progeny were superior in 40% and DC- sired in 12% in all the traits measured. HS Sired progeny were superior in 70% of all traits, while those of LW sires showed superiority in only 30% of the traits in the post-weaning phase. The Hampshire breed is recommended as the preferred sire breed for crossbreeding purposes to bring about genetic improvement in growth of pigs in a humid tropical environment. Regressions (R^2) of body weights on Linear body measurement were all very highly significant ($P<0.001$) except at 70 days where R^2 was poor (10.5%). The determined prediction equation shows that BL and RG could be effectively used to predict body weight of pigs.

Key words: Breed of sire, growth performance and humid tropics

INTRODUCTION

Pigs have high prolificacy and have tremendously contributed towards the improvement of human nutritional intake by increasing both the quality and quantity of available protein in form of pork and pork product. However, improvement is still needed in the areas of product composition and production efficiency, especially with regard to growth, disease resistance and reproduction Hollis[1]. Improvement in production efficiency of pigs has been based on development and application of quantitative genetic principles of selection and mating system Wheeler and Campion[2] Growth characteristics of pigs are inherited consequently, it is necessary to evaluate different genotypes for their growth performance in order to determine those that should be exploited to bring about rapid genetic improvement through selection efforts in the tropics.

Evaluation of the performance of animals constitutes an essential part of successful breeding plans for sustainable genetics improvement. Tropical breeds of pigs have low reproductive and growth efficiency. This has brought about increased clamor for upgrading their breeds with exotic breeds, which have high reproductive and growth potential Hollis,[1]. For upgrading to be effective the exotic parent must be of proven performance under the prevailing environmental condition. Crossbreeding efforts in Nigeria has led to the introduction of productive genes from exotic breeds, such as pure, large white and Hampshire into unimproved local pig population. This offers the opportunity to increase genetic variation from which leaner and more efficient animals can be selected Wheeler and Campion[2]. According to Afolayan *et al.*[3], crossbreeding is an important animal breeding tool for the improvement of traits like growth, Musculature and survival. It could also be used for enhancing weight and average daily gain in animals including pigs.

Bittante *et al*[4] reported that Land race sired pigs had a growth rate higher than large white purebred pigs after

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weaning. Simpson *et al*[5] reported that Duroc progeny grew faster at the rate of 0.02 kg than large white progeny in three way cross breeding scheme, when they were fed adlib. The hereditability values and genetic variability therefore suggest that post weaning performance could be improved through crossbreeding. Breeds differing in their production characteristics can be utilized in specific crossbreeding schemes to effect both average genetic effect and heterosis in view of the fact that the optimum breeding system in pigs seems to involve a two line crossbred dam mated to a terminal sire. The objective of the study was therefore to determine the effect of breed of sire on growth performance of exotic crossbred pigs in a humid tropical environment.

MATERIALS AND METHODS

Location: The experiment was carried out the Piggry Unit, Michael Okpara University of Agriculture Teaching and Research Farm, geographically located in Abia State, Nigeria on Latitude 05.29 North, Longitude 07.33 East and an altitude of 122 meters above sea level. It lies within the humid rain forest zone of West Africa which is characterized by long duration of rainfall (March-October) and short period of dry season (November to February). Average rainfall is 2169 millimeter in 148-155 rain days. Average ambient temperature is 20^{oC} with maximum of 32 and minimum of 20^{oC}. Relative humidity reneges from 50 to 75%.

Breeding procedure: Three breeds of pigs namely, Large White (LW), Duroc (DC) and Hampshire (HS) were used for the study. A total of fifteen pigs made up of three boars of different breeds and twelve large white sows were used to produces the experimental animals. The mating ratio was one boar to four sows. A total of 96 pig lets produced from the three crosses were used for the experiment. The number of progeny produced and average litter size in each cross were as follows Table 1.

Management of experimental animals: A diet containing 20.1% crude protein and 3368kcal/kg M.E. was fed to the piglets as starter mach, while a diet with 19.0% crude protein and 2808 kcal kg^{-1} M.E was fed to the growers as growers mash. The animals were fed ad-lib and enough water was also provided. Administration of iron injection and deworming was also carried out. The experiment lasted for seven months (i.e., the preliminary phase which is the mating/gestation period which lasted for four months, while the period for data collection on the crossbred progeny lasted for three months

Experimental design and data collection: The experiment was designed as a Complete Randomized Design (CRD). The statistical model is

$$Y_{ij} = \mu + \beta_1 + e_{ij}$$

Where:

Yij = the jth observation in the ith breed of sire
μ = overall mean
$\$_1$ = main effect of breed of sire
e_{ij} = random error identically and independently, normally

distributed with zero mean and constant variance(2nd(0 6^2)).

Data were collected fortnightly on the following; Body Weight (BW). Body Length (BL) Height at withers (HW), Heart girth (HG) and rear girth (RG) of the progeny of each cross for three months.

Body Weight (BW), which represent the weight of the animal was measured with a sensitive scale calibrated in 0.1 kg. Body Length (BL), the length of the animal from the last cervical to the lumber vertebra (base of the tail), Heart Girth (HG), the circumference of the chest region and rear girth (RG) the circumference of the loin region; were measured with a measuring tape and ruler calibrated to 0.1 cm.

The data were subject to analysis of variance appropriate for a completely randomized design, using Harvey's[6] Least square and maximum likelihood computer programme, significant means were separated with Duncan's New Multiple Range test Duncan[7].

Predictions of body weights at different ages with Linear Body parameters (LBM) were also carried out using the stepwise multiple regression procedure of SPSS. Each model is of the general form.

$$BW = a + b_1 x_1 + b_2 x_2 - \text{---} b_{xk} x_k$$

Where:

BW = Body weight for the ith age
a = intercept
b_1 - - b_k = partial regression coefficient
x_1 ---x_k = linear body parameter

RESULTS AND DISCUSSION

Effect of breed of sire-on pre-weaning growth parameters: Table 1 and 2 present some performance characteristics and means of various pre-weaning (0-56 days) growth parameters for crossbred progeny of

Table 1: Performance characteristics of crossbred pigs

	LW x LW	HS x LW	DC x LW
No of Dam	4	4	4
No. of progeny	30	32	34
Av. Litter size	9.25	8.25	9
Av. No. Weaned	7.5	8	9
Av. Mortality	0.19	0.03	0.029
Av. Daily gain (kg)	0.46	0.48	0.42
FCR (feed/Weight gain)	3.67	3.47	3.98

Table 2: Means of various pre-weaning growth parameters for crossbreds of different breeds of sire

Ages(days)	Breeds of sire* progeny	Body weight (BW) kg	Body length (BL) (cm)	Height at withers (HTW)cm	Heart girth (GH) cm	Rear girth (RG) cm
	LWxLW	1.10±0.039^{a}	31.76±0.356^{a}	15.53±0.299^{a}	20.67±0.348^{b}	21.07±0.407^{a}
BIRTH	HS x LW	1.07±0.039^{a}	31.16±0.350^{a}	17.32±0.294^{b}	20.29±0.343^{b}	20.84±0.401^{a}
	DCxLW	0.92±0.036^{b}	29.94±0.334^{b}	18.53±0.281^{c}	21.94±0.327^{a}	18.35±0.38^{b}
	LWxLW	2.67±0.134	42.10±0.797	21.90±0.361^{b}	28.07±0.383^{b}	31.12±0.549^{a}
14	HSxLW	2.67±0.130	40.88±0.772	22.38±0.350^{ab}	30.42±0.371^{a}	28.55±0.532^{a}
	DCxLW	2.44±0.126	40.68±0.749	23.32±0.339^{a}	29.27±0.360^{a}	28.24±0.516^{b}
	LWxLW	4.31a±0.170	51.90±0.946	26.37±0.483	34.07±0.664	33.97±0.708
28	HSxLW	4.21±0.164^{a}	49.38±0.916	26.97±0.463	35.31±0.643	32.94±0.685
	DCxLW	3.57±0.159^{b}	51.24±0.889	27.18±0.454	34.56 ±0.624	32.82±0.665
	LWxLW	5.54±0.259^{a}	57.57±1.064^{a}	28.63±0.577	36.67±0.748	36.40±0.770^{a}
42	HSxLW	5.75±0.251^{a}	57.94±1.030^{a}	30.06±0.559	38.16±0.724	37.64±0.746^{a}
	DCxLW	4.51±0.244^{b}	54.59±1.000^{b}	28.97±0.542	37.97±0.702	34.38±0.723^{b}
	LWxLW	7.31±0.320^{a}	62.07±0.991	30.70±0.562^{a}	38.60±0.0771	38.60±0.796
56	HSxLW	676±0.31^{a}	62.78±0.960	32.66±0.544^{a}	40.47±0.746^{ab}	39.28±0.796
	DCxLW	5.88±0.301^{b}	60.09±0.931	29.41±0.931^{b}	42.00±0.724^{a}	38.50±0.747

a-b: Means with different superscripts within the same column are significantly different ($p<0.05$) · LW = Large White, HS = Hampshire and DC = Duroc

three breed of sire. The results show increase in body weight with age which agree with the reports of Dillard *et al*[8], Oliver[9] and Atkins[10]. The analysis of variance indicate significant effect ($p<0.05$) of breed of sire on Body Weight (BW) of the progeny at birth at 28,42 and 56 days.However, no significant ($p>0.05$) difference in body weight at 14 days among the progeny of the different breeds of sire were noted. It was also observed that LW-sired and HS-Sired progeny had higher body weight-than Duroc-Sired.

Progeny at all ages studied. This agree with the result obtained by Adebambo 1983, but contrary to the result of Agbagba *et al.*[12] who reported that LW sired offspring had slightly lower birth weight and weaning weight than HS-sired offspring. It is also contrary to the observation by Bittante *et al.*[4] and Simpson *et al.*[13] that DC-sired progeny are heavier than progeny of LW-sired at 28 days when fed ad. Lib.

There was significant effect ($p<0.05$) of breed of sire on Body Length (BL) at birth and 42 days with LW and HS-sired progeny having significant ($p<0.05$) higher values than Duroc-sired-offspring. This trend was similar to that obtained for body weight. Affentranger *et al.*[14], also observed significant breed difference ($p<0.05$) for Body length among the progeny of LW, DC and Landrace (LR) sires. Generally the observation is similar to that obtained in this study, since the progeny of LW – Sired had superior body length when compared with the others.

Significant difference ($p<0.05$) were observed in Height at Wither (HTW) at birth, 14 and 56 days. Contrary to the trend for body weight and body length, Duroce-Sired progeny recorded the highest withers height at birth (18.53 cm), 14 days (23.30 cm) and 28 (27.8 cm) days, while those of large white-Sired had the lowest (15.33 cm, 21.90 cm and 26.73 cm, respectively). Simpson *et al.*[13] Young, Khuler *et al.*[15], found that Duroc used as sire breed in various two or three way- crossing schemes improved growth rate. There were significant ($p<0.05$) difference in Heart Girth (GH) at birth, 14 and 56 days for LW – sired crossbreds. However, the progeny of HS and DC sires were not significant difference ($p>0.05$) for this trait at 14 and 56 days. Breed of sire differences were significant ($p<0.05$) for rear girth (RG) at birth 14 and 42 days. LW and HS-sired progeny were superior to DC-sired progeny at birth and 42 days, respectively.

Effect of breed of sire on post-weaning growth parameter (70-84 days): Table 3 gives the means of various post-weaning growth parameter for crossbred of different breeds of sire. There were significant difference ($p<0.05$) for Body Weight (BW) at 70 and 84 day among the different breeds of sires. At 70 days, HS- Sired progeny had significantly higher body weight than progeny of other breeds. This is in line with the observation by Glodeck[16] that parental effect of HS-sired progeny on pig weights were high and positive, post-weaning and slightly higher than that of LW-Sired progeny.

Table 3: Mean of various post-weaning parameters for crossbreds of the different breeds of sire

Ages(days)	Breeds of sire* progeny	Body weight (BW) kg	Body length (BL) (cm)	Height at withers (HTW)cm	Heart girth (HG) cm	Rear girth (RG) cm
	LWxLW	8.52±1.287^{ab}	68.77±1.097^{a}	36.37±0.710	41.70±0.739^{b}	4.10±0.831^{b}
BIRTH	HS x LW	10.81±0.1246^{a}	68.78±1.062^{a}	36.16±0.688	44.19±0.715^{a}	42.84±0.804^{a}
	DCxLW	6.18±1.209^{b}	64.00±1.030^{b}	34.47±0.667	39.65± 0.694^{c}	38.74^{c}±
	LWxLW	10.15±0.442^{a}	74.13±1.807	39.47±0.918	44.97±0.943^{b}	44.83±0.903^{b}
14	HSxLW	10.70±0.422^{a}	74.00±1.723	36.88±0.876	48.00±0.0899^{a}	48.09±0.861^{a}
	DCxLW	7.90±0.422^{c}	69.42±1.723	38.85±0.876	41.97±0.899^{a}	41.64±0.861^{c}

a-b: Means with different superscripts within the same column in each age are significantly different ($p<0.05$) * See Table 2: For meaning of breed abbreviations

Table 4: Prediction equations for body weights using linear body measurements at various ages

Age(days)	Prediction equation	R^2(%)	S.E	F
Birth	- 1.374+05BL+0.04RG	75	0.1129	0.001*
14	- 3.592+0.12BL+0.06HTV	55.7	0.4942	0.001*
28	- 6.140+0.09BL+ 0.06HTW	55.7	0.4942	0.001*
28	- 6.140+0.09BL + 0.097HG + 0.08HTW	69.8	0.54554	0.001*
42	-7.735+ 0.14BL + 0.15RG	78.6	0.7069	0.001*
56	-11.305+0.19BL + 0.16RG	75.5	0.9182	0.001*
70	-13.662 + 0.58HG	10.5	6.8832	0.001*
84	-11.906+0.203HG+0.68BL + 0.14RG	78.7	1.2658	0.001*

* Highly significant ($p<0.001$)

There were significant effect ($p<0.05$) of breed of sire on Body Length (BL) at 70 days with LW and HS-sired progeny having significantly higher value than DC-sire progeny. However, the three breeds of sire were not significant different ($p>0.05$) at 84days for this traits. Progeny of LW-sires had numerically higher values than progeny of other sires. This is in agreement with the results obtained by Adebambo[11] Simpson *et al.*[13], MCG loughin *et al.*[17] and Lanlois and Minvielle[18] who reported that the body of LW-sired progeny are longer than those of HS and DC-Sired progeny.

There were no significant differences ($p>0.05$) in height at withers (HTW) among the three breeds of sires at 70 and 84d. However, numerically LW- Sired progeny ranked highest in height post weaning. significant ($p<0.)5$) difference were obtained in Heart Grith (HG) at 70 and 84 with the HS-sired progeny recording the highest value. Tegbe and Olurunju[5] reported that heart girth is an indicator of tissue growth (muscle development and fatness) and that live weight was best predicted using HG measurement and for a quick tool on the field and with minimum difficulty, live weight of cross lined pigs can be readily estimated using HG alone. Breed of sire differences were significant ($p<0.05$) for Rear Girth (RG) at 70 and 84d. This result is similar to that obtained for body weight and heart girth pre-pre-weaning. This indicates that there are inter-relationship among BW HG and RG. Jeffery and Berg[19], reported that these three traits are good indicators of live weight as the reflect body condition.

Prediction models for body weights at different ages with Linear Body Parameters (LBM) are shown in Table 4. A study of the relationship between the live weight and body measurements of crossbred pigs will enable one to come up with prediction equations which will be handy tools for researchers and prospective pig buyers in most of our villages. Weighing scales are common features on most government farms but it is a difficult picture in the villages.

The result shows that BL and RG could effectively be used to predict body weight at birth, 42 and 56d, while BL and HTW could be used for the prediction at 14 and 28d. The coefficient of determination (R2) were all very high and the regression were highly significant ($p<0.001$). At 70d the HG appeared to be the single predictor of body weight with its coefficient of determination of 78%. According to Tegbe and Olurumju[5], HG RG and BL could be used for body weight prediction in pigs. The prediction model show that body length and rear girt are the best prediction of pig body weight he result indicates the overall superiority of HS-sired progeny over- t progeny of the other breeds of sire. This could be attributed to the effect of the favourable dominant genes brought into the crosses by the HS-sire. DC-Sired progeny had the lowesi Post-Weaning weight, which shows that the Duroc is not the breed of choice as sire in crossbreeding programmes designed to achieve fast growth in a humid tropical environment.

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