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EVALUATION OF MORPHOMETRIC TRAITS AND HETEROTIC EFFECT OF CROSSBRED *MUTURU* AND WHITE FULANI CATTLE REARED IN NASARAWA STATE NIGERIA

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ABSTRACT

The experiment was carried out to determine the heterotic effect of some Morphometric characteristics of Crossbred of Muturu and White Fulani Cattle reared in Nasarawa State using artificial insemination (AI) procedures. This experiment was carried out during the period of dry season and moderate rainy season (October to May) between 2022 and 2024. Fifty-five (55) matured Muturu cows were crossbred via artificial insemination process using pooled semen from ten (10) White Fulani bulls. Forty-eight crossbred calves were produced (30 females and 18 males). Data on body weight and different morphometric traits were taken from the calves at 12 months old and analysed using SPSS version 20 window. The results showed that all the traits were significantly ($P<0.05$) different between the crossbred and the parents indicating direct and positive heterosis over and above the parents. The results of direct and positive heterosis for the crossbred bulls had values for CG (12.86%), HW (5.22%), BL (49.56%), EL (12.60%), HL (16.89%), NL (9.09%), FL (5.72%), BW (15.29%) and WW (7.18%) at 12 months old. Similarly, positive and direct heterosis of the crossbred heifers was recorded alsoat 12 months old with values for CG (9.28), HW (9.82%), BL (9.48%), EL (57.78%), HL (14.05%), NL (27.84%), FL (14.65%), BW (30.44%) and WW (8.25%). Heterosis was also observed in both the crossbred bull and heifer calves. It was concluded that crossbred calves grew faster than their inbred parents and improvement in morphometric traits was a result of crossbreeding effects.

Keywords: Evaluation, Heterosis, Morphometric traits, Muturu, White Fulani and Crossbred.

1.0 INTRODUCTION

Crossbreeding 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). Crossbreeding in commercial animal production system is mainly aimed at increasing hybrid vigour impact in crossbred genotypes. It is a means of combining breeds (complementarity) deficiencies in one breed by the other.Nwakpu *et al*. (2016) reported that in animal breeding, crossbreeding allows the exploitation of breed qualities from genetic and biological points of view. Crossbreeding may lead to improved performance of the crossbred over the parents. This improved performance is recognized as heterosis.

Exploitation of heterosis is a major reason for crossbreeding in farm animals (Ibe *et a*l., 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).

Ogbuagu *et al*. (2023) reported positive heterosis (hybrid vigour) for body weight and all linear body traits measured in the main and reciprocal crossbreds of domestic turkeys studied.Geoff (1998) had reported that the most desirable form of heterosis is the better parent heterosis, a situation where the resulting progeny outperforms the superior parent. Although attaining this level of improvement is somewhat difficult, it still remains the target of most breeders.

Muturu are small bodied cattle known as the West African dwarf short horn. *Muturu* have blocky conformation with short limbs. It is characterized with a compact body, a straight back with no hump, and a broad head with very short horn (Kubkomawa, 2017). *Muturu* cattle are raised primarily for their meat, which is highly valued by consumers due to its organoleptic qualities (Adolighe *et al*, 2020).

Muturu cattle are reportedly very fertile with a capacity to produce one viable calf per annum According to (Tijjani *et al*., 2019).Ezekwe and Kamalu (2000) reported that *Muturu* heifers under improved management attain puberty at an early age (12.25 – 14.60 months) and weighed 90.50kg and 85.20kg for supplemented and un-supplemented feeding, respectively.

They mature earlier than the Zebu in the region and the intervals between consecutive calvings were shorter (Adebambo, 2001).

The White Fulani, also known as '*Bunaji*' is a type of West African Zebu that is indigenous to Northern Nigeria, Southern Niger and Northern Cameroon (Desie & Mwai, 2019). White Fulani is the most numerous and widespread of all Nigerian cattle breeds (Kubkomawa, 2017).The White Fulani are however, important for their genetic predisposition of hardiness, heat tolerance, and adaptation to local conditions (Alphonsus *et al*, 2021). White Fulani cattle is a white, black eared and medium-horned breed (Blench *et al*, 1999). The White Fulani are generally taller and narrower bodied cattle, the average birth weights computed in the different regimes range from 18.2 to 24.2kg; mature weights of bulls and cows in the improved systemof management is 350 – 665 and 250 – 380kg, respectively (Tawah and Rege, 1996).

The *Muturu* breed is known to be more resistant to *trypanosomiasis* than the White Fulani, while the White Fulani is known to be more heat tolerant and resistant to dermatophilosis than the Muturu and also resistant to intestinal helminth parasites (Tawah and Rege, 1996). There is need for improving the productivity of uniquely adapted animal genetic resources (ANGR) for use both within the country and for export purposes.Improving the reproductive performance of *Muturu* cows in Nigeria can greatly impact on increasing beef production as well as encourage ample inclusions of substantial population of *Muturu* cows into any genetic improvement programmes (Nwakpu*et al.,* 2016).

Artificial insemination (AI) is one of the best alternatives to introduce new genes into the Muturu herds. Bo *et al.* (2013) suggested that, the most useful alternative to significantly increase the number of animals involved in AI programmes is the use of protocols that allows for AI without the need for estrus detection, usually called Fixed Time Artificial Insemination (FTAI) protocols.One of the main advantages of implementing FTAI programmes are that, more cows can be impregnated earlier in the breeding season to genetically improved bulls or semen of it resulting in heavier weaning weights (Cutaia *et al.,* 2013).

Due to their adaptability, disease resistance, high reproductive rate and resilience, the *Muturu* cows of Nigeria could play significant roles in achieving sustainable cattle production under the harsh environmental and low input traditional production system (Nwakpu *et al.*, 2016).

This study was designed to evaluate the Morphemetric traits and heterotic effect of crossbred *Muturu* and White Fulani Cattle reared in Nasarawa State Nigeria.

2.0 MATERIALS AND METHODS

2.1 Location of the Study

This study was conducted at Akwanga, Karu and Wamba Local Government Areas in Nasarawa State, North Central Nigeria. This experiment was carried out during the period of dry season and on-set of rainy season (October to May), between the years 2022 to 2024. The experiment was conducted at three different locations; Akwanga, Karu and Wamba Local Government Areas in Nasarawa State. 60 adult *Muturu* cows were inseminated using semen from 15 different White Fulani bulls. 51 crossbred calves were produced (32 females and 19 males). Morphometric measurements were taken when the calves where 12 months old, these measurements were compared with the Morphometric measurements of their corresponding parents.

2.2 Artificial Insemination Procedures

A modified co-synch (FTAI) protocol involves day 0 where the animals were administered GnRH (gonadotropin releasing hormone) and CIDR (controlled internal drug release). This was followed by day 7; here the animals were administered eCG (equine chorionic gonadotropin) and PG (prostaglandin Fα). CIDR were subsequently removed and on day 10 and the animals were artificially inseminated. The semen used for the experiment was purchased from a reputable farm in Ota, Ogun State. They were obtained from sound and proven breeding bulls of the While Fulani breed. The semen was thawed by bringing it out from the ice and exposing to warmth for 5 minutes and then, it was loaded into the insemination gun and inseminated into the animals. All the cows were inseminated twice daily morning and evening.

2.3 Morphometric Traits

For the evaluation of morphometric traits, data were collected and recorded using a format based on standard breed descriptor list developed by FAO (2012). The parameters were obtained by a measuring stick modified with a sliding calliper encompassed by an adapted tape calibrated in centimetres (cm) after restraining and holding the animals in an unforced

position. All measurements were taken early in the morning prior to feeding while cows are tethered during measurement. Linear body measurements were taken as shown in Table 1.

Table 1: Linear body measurements and Procedures used for measurement.

S/N	Measurements traits	Measurement Procedures
1	Chest girth (CG)	Measured by taking the measurements of the circumference of the chest, behind the forelegs.
2	Height at withers (HW)	Measured as a distance from the surface of the platform to the withers of the animal.
3	Body length (BL)	The distance from the point of shoulder to the pin bone
4	Ear length (EL)	Taken from the base to the tip of the ear
5	Head length (HL)	The length of the front head from the middle of the top head of the end of the mouth.
6	Neck length (NL)	The length between the atlas vertebrate till the vertebrae just ahead of the first thoracic.
7	Hind Limb (HDL)	From the hip bone to pin bone (outside)
8	Fore Limb (FL)	From the breath in points of shoulder points
9	Birth Weight (LW)	Taken early in the morning before proceeding with feeding the animals.
10	Weaning Weight (WW)	Taken early in the morning before proceeding with feeding the animals.

(FAO, 2012)

2.4 Statistical Analysis

The data were collected and analysed using T-test in SPSS version 20 window. The calves from the two genotypes were classified according to their sex.

2.5 Estimation of Heterosis

Heterosis was calculated using the data obtained from the parents and the crossbreds

2.6 Heterosis: Direct and percentage heterosis for each cross was estimated with the method of linear contrasts as outlined by Dickerson (1992), as follows:

Direct heterosis= Mean of the crossbred – Mean of parental purebreds.

$$\textbf{Percentage heterosis} = \frac{\text{Direct heterosis}}{\text{Mean of purebreds}} \times \frac{100}{1}$$

3.0 RESULTS AND DISCUSSION

The results of the body weight (BW) and other morphometric traits of inbred parent and F1 crossbred bulls and heifers at 12 months old are presented in Table 2 and Table 3 respectively. The results showed that, all the traits were significantly (P<0.05) different between the crossbred calves indicating direct and positive heterosis over and above the inbred parents. In Table 2 below, results of direct and positive heterosis for the crossbred bulls had values for CG (12.86%), HW (5.22%), BL (49.56%), EL (12.60%), HL (16.89%), NL (9.09%), FL (5.72%), BW (15.29%) and WW (7.18%) at 12 months old.

In Table 3, similar positive and direct heterosis of the crossbred heifers was recorded also at 12 months old with values for CG (9.28), HW (9.82%), BL (9.48%), EL (57.78%), HL (14.05%), NL (27.84%), FL (14.65%), BW (30.44%) and WW (8.25%). These findings is comparable with the results of Adolighe *et al.* (2020) and Nwakpu *et al*. (2023) who reported significant (P<0.05) difference between the crossbred calves(bulls and heifers).

Table 2: Morphometric measurements (cm) and Body weight (kg) of Parent cows (inbred) and their F1 Crossbred calves (cows) at 12 Months old.

Traits (cm)	Muturu cows	F1 crossbred calves (heifers)	% Heterosis
Chest girth (CG)	41.30 + 2.03^{b}	46.57 + 5.11^{a}	12.86
Height at withers (HW)	42.08 + 5.11^{b}	44.28 + 2.35^{a}	5.22
Body length (BL)	20.50 + 3.71^{b}	30.66 + 3.22^{a}	49.56
Ear length (EL)	15.22 + 4.64^{b}	17.14 + 8.33^{a}	12.60
Head length	21.96 + 5.10^{b}	25.67 + 9.02^{a}	16.89
Neck length (NL)	16.05 + 8.01^{b}	17.51 + 3.40^{a}	9.09
Hind Limb (HL)	43.31 + 5.42^{b}	46.77 + 3.55^{a}	7.98
Fore Limb (FL)	35.81 + 3.66^{b}	37.86 + 3.44^{a}	5.72
Birth Weight (BW)	13.54 + 4.29^{b}	15.61 + 8.73^{a}	15.29
Weaning weight (WW)	42.87+ 4.33^{b}	45.92 + 3.08^{a}	7.18

$^{a-b}$ means in the same row with different superscripts are significantly different (P<0.05). Chest girth (CG), Height at withers (HW), Body length (BL), Ear length (EL), Head length, Neck length (NL), Hind Limb (HL), Fore Limb (FL), Birth weight (BW) (kg), Weaning weight (kg).

Table 3: Morphometric measurements (cm) and Body weight (kg) of Parent bulls (inbred) and their F1 Crossbred calves (bulls) at12 Months old.

Traits (cm)	White Fulani bulls	F1 Crossbred calves (bulls)	% Heterosis
Chest girth (CG)	55.41 + 5.01[b]	60.55+ 6.04[a]	9.28
Height at withers (HW)	52.70 + 4.02[b]	57.88 + 2.11[a]	9.82
Body length (BL)	39.02 + 5.11[b]	42.72 + 2.01[a]	9.48
Ear length (EL)	15.80 + 7.21[b]	22.93 + 5.33[a]	57.78
Head length	30.32 + 4.87[b]	34.58 + 1.63[a]	14.05
Neck length (NL)	20.40 + 4.11[b]	26.08 + 2.66[a]	27.84
Hind Limb (HL)	58.04 + 5.17[b]	63.44 + 5.17[a]	9.30
Fore Limb (FL)	45.09 + 1.04[b]	51.70 + 3.04[a]	14.65
Birth weight (BW)	16.62 + 2.50[b]	21.68 + 1.55[a]	30.44
Weaning weight	57.93+ 3.15a	62.71 + 1.35[a]	8.25

[a-b] means in the same row with different superscripts are significantly different (P<0.05). Chest girth (CG), Height at withers (HW), Body length (BL), Ear length (EL), Head length, Neck length (NL). Hind Limb (HL), Fore Limb (FL), Birth weight (BW) (kg), Weaning weight (kg).

Nwachukwu *et al*. (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. Peters *et al.* (2007) reported increase in body weight observed in the progenies as they approach sexual maturity and also consistent increase in body weight as age increased.

Heterosis was observed in the crossbred calves. Crossbred calves grew faster than their inbred parent. Breed complementarity is the major advantage of crossbreeding. This relates to the fact that there are no perfect breeds and that each breed possesses certain strengths and weaknesses. In a systematic crossbreeding programme, breed resources are combined to balance the positive and negative aspects of each breed in the genotypes. Estimation of the percentage direct heterosis of the body weight of the calves at 12 months of age was positive.

Improvement in morphometric traits as a result of crossbreeding have also been reported to be significantly (P<0.05) different between the crossbred calves by Adoligbe *et al*. (2020); Kubkomawa (2017) and Tijjani *et al*. (2019).The results obtained suggest that simultaneous selection for body measurement and growth traits is feasible. It also suggests that any one among the morphometric traits or their combinations could be used to predict live weight in calves, though variations existing in values for different climes, environment and breed combinations. The result obtained in different breed combination for body weight and

morphometric traits showed that there are differences in body conformation of these genotypes reared in different environments; though they belong to the same breeding group.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Direct and positive heterosis was observed over and above the inbred parents. Heterosis occurred in both the crossbred bull and heifer calves. Crossbred calves grow faster than their inbred parents in the three different locations.

4.2 Recommendations

Adequate management and breeding techniques should be maintained during Cattle breeding and research work to enhance increased efficiency in achieving the research objectives. Provision of technical staff in the research centres will all help in collection of data from the animals.

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