# THE EFFECT OF CROSSBREEDING PROGRAMMES, SEASON ON WEIGHT AND LINEAR TRAITS OF PRE-WEANED NIGERIA GOATS

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**Abstract**

An experiment was conducted to evaluate the effects of different crossbreeding programmes and seasons on pre-weaning weights (PW) and linear body measurements (LBMS), namely, height-at-withers (HW) and body length (BL) for Nigerian purebred goats and their crosses using 176 pre-weaner does. Two breed stocks were used: West Africa dwarf goat (WADG) of Savannah ecozone, Red Sokoto goat (RSG) of desert ecozone which generated five breeding programmes through a complete diallel crosses. The result showed there was significant effect of breed that involved crosses of RSG x $F_1$ (RSG x WADG). Breeding involving WADG x RSG and RSG x RSG had comparable weaning weights that are inferior to the back cross (RSG x $F_1$). The least weight was recorded by pure WADG of the savannah ecozone. The weaning weight was significantly highest ($P<0.05$) in early rainy season (April-June) but were statistically similar with other seasons. The breeding programmes of early rainy (April-June) and late rainy season (July-September), early dry (October-December) and late dry out (January-March) seasons generally recorded the least results. The result also showed progressive increase in linear body parameters for RSG x $F_1$ crosses, RSG x WADG and WADG x RSG in that order over the pure breds. The effect of breed on height-at-withers and body length were significant ($P<0.05$). The RSG x RSG maintained superiority on HW and BL over others. The linear body measurements generally were least for the pure WADG x WADG of Savannah ecozone ($P<0.05$). The Results suggest that RSG x F1 (RSG x WADG) programmes should be utilized for growth improvement of Nigerian indigenous WADG.

**Keywords:** crossbreeding programmes, seasons growth performance, Nigerian goat

## 1. Introduction

There is currently an unprecedented shortage of animal protein in the daily diet of the average Nigerian. The situation is worst in high density area on the country where bush meat from wild animals or fish from the village streams are both difficulty to come by. At present the meat and eggs cost beyond the financial reach of most families due to avian flu that crippled most farms.

Breeding programmes have been adopted to genetically improve growth characters that are subject to gene action. Haas (1978) observed that when crosses are made between two parental lines which differ genetically such as different inbred lines or strains within a particular species, improvement is generated in the resulting $F_1$ offspring. Inbreeding depression has been known for centuries to have deleterious effects on offspring fitness (Darwin, 1876; Malecot, 1948, Falconer and Mackey 1996, Lynch and Walsh, (1998). Nwakalor and Obochi (2000) had reported positive linearity by weight in all possible crosses for three breeds of rabbits. However, Halluar and Sears, (1973), Good and Hallauer, (1977), have reported negligible departures of positive linearity in some studies of domestic animals. Similarly, Das (1989) and Haas (1978) reported low improvement on linear parameters on crosses of domestic animals due to a change in the environment. Reciprocal effects could also be utilized in crosses. Singh *et al.* (1983)., Good and hallauer, (1977) noted that reciprocal effect was vital for growth improvement in the cross and pure bred black Dengal goats. The body weight of live animal as a comprehensive measure of growth is subject to availability of food which may be altered seasonally particularly if outdoor feeding is part of the husbandry. The growth patterns of such animals tend to be stunted, during the unfavorable season when there is shortage of forages. Hence, genetics and seasonal manipulations can propose a breeding linkage programmes as a solution for differences between breeds and seasons. Therefore, different breeding programmes in conjunction with assessment of seasons on their growth may provide the breeds with something positive to offer to livestock industries. The objective of the study was to asses the influence of different breeding designs at different seasons on the growth of Nigerian pure breed goats and their crosses. Embarking on special breeding programmes involving only our indigenous breeds rather than exotic will to a large extent remove the troubles associated with the exotic. The establishment of an improvement breeding programmes for our indigenous goats will help to conserve our almost extinct local strains with their potentials that could be eroded by the exotic.

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## 2. Materials and Methods.

The experiment was conducted at the small Ruminant Improvement and Multiplication Research Unit of the Department of Animal Science and Fisheries, Enugu State University of Science and Technology (ESUT), Abakaliki Campus. Abakaliki which is located within the derived Savannah with mean annual rainfall of 1117mm and maximum daily temperature of 34 °C and the relative humidity of about 85 % (Ofomata, 1975). The experiment was conducted from 1995-2003. Four seasons were identified for the purpose of the study.

These include:

1. January-March (late dry season)
2. April-June (Early rainy season)
3. July-September (Late rainy season)
4. October-December (Early dry season)

(a) Experiment Animals, Design and Management

Six bucks of each breed were mated to 12 does each of the two Red Sokoto and West African dwart goats (Table 2). They were identified by neck tagging and housed in pens at one per pen. From 8:00 am-12 pm and 4:00 pm-6:00 pm everyday, the goats were sent out to graze in the university grazing fields containing both native and introduced pastures, browse plants and leguminous herbages (Table 1). The animals were fed with concentrate ration mixture of poultry growers mash (3 %), crushed maize grains (4 %), bambara nut chaff (2 %) body weight Fresh clean water was served *ad libitum*. The animals were routinely treated against parasites. They were vaccinated against pestes de petit ruminant PPR) with tissue culture rinderprst vaccine (TCRV). Mating was arranged between males (sires) and females (dams) of identified and isolated ecotypes (likes and unlikes) (see Table 2). The mating of the likes and unlikes were by a permutated design that involved the mating of the sub-group from the different ecozones. Checkerboard and or branching were also used in accordance with the breeding objective. Two pure breeds of goats were used in the study, namely West African Dwart goats (WADG) and Red Sokoto goat (RSG) from which a total of five mating programmes were established (Table 2). From the dams, data were collected in every two weeks from the kids they generated. Each programme generated twelve doe kids with exception of body weight which were measured in (cm) using tailors tape. The environmental factors whose effect on these traits were measured are early (April-June), late rainy (July-September) early dry (Oct-Dec.) late dry (Jan.-March) seasons, designated as 1, 2, 3, and 4 with their corresponding months for the purpose of the study. Pre-weaner weights and the linear body measurements were taken on each animal from birth to 10 weeks of age. Body length was taken from the point of shoulder to the pin-bones and height-at withers from the forelimbs toe base to the hump bone in each of the programmes.

(b) Data Analysis

The experiment was a $4^5$ factorial in a complete randomized design with four seasons and five breeding programmes. Where significant differences between means were observed, Duncan's New Multiple range test was used for separation (Duncans, 1955).

The statistical fixed linear model adopted is expressed as:

$$Y_{ijk} = E_i + b_i + S_j + e_{ijk}$$

where

$Y_{ikj}$ = the $K^{th}$ observation on the $j^{th}$ breed in the $k^{th}$ season

$b_i$ = fixed effect of $i^{th}$ cross breeding programmes = (1 ...5)

$S_j$ = fixed effect of the $j^{th}$ season (j...4)

$e_{ijk}$ = random error

## 3. Results

The list of browse plants, grasses, upon which the animals fed, were listed in Table 1.The analyses of the result of pre-weaning weights of the five breeds and in their different seasons are shown in Table 3. The results show that there were significant differences ($P<0.05$) in the pre-weaning weights of the purebreds and the rest of the crossbreds, pre-weaning weight was significantly higher ($P<0.05$) in RSG x $F_1$ ($F_2$ backcross) than the rest of other breeding programmes. However, no significant ($P<0.05$) differences existed between the purebred WADG of the savannah and the Red Sokoto breeds of sahed ecozone. Similarly, no significant difference, in pre-weaning weight existed between the main and reciprocal breeds. The results further show that the RSG x $F_1$ recorded highest pre-weaning weight followed by the reciprocal and the main crossing in that order.

The effect of season on weight was highest for early rainy season ($P<0.05$). No significant ($P<0.05$) differences existed in weight for the other three seasons. The performance results of the linear body measurements for the five breeding programmes (genotypes) showed superiority of the RSG x RSG ($P<0.05$) over the rest of the breeds. Both the HW and BL were significantly higher ($P<0.05$) than the rest of the other breeds. (Tables 4 and 5). However, the crossbreds are comparably higher than the pure WADG which recorded the least values in HW and BL ($P>0.05$).

## 4. Discussion

The significant effects of breeds and season of rearing on the pre-weaning weight suggest that crossbreeding programme particularly the RSG x F1 should be adopted in improvement programmes for Nigeria goats. The programme significantly promoted the

TABLE 1: The list of grass and browse plants in the grazing field and concentrate feeds on which the experimental animals were fed

| | Type/species | Common name | Remarks |
|---|---|---|---|
| A. | *(i) Adropogon gayanus* | (Gambia grass) | perennial late flowering |
| | *(ii) Panicum maximum* | guinea grass | Perennial early flowering |
| | *(iii) Hyparrsphenia rufa* | (red thatching) | Annual late flowering |
| | *(iv) Setaria barbata* | (water grass) | creeping |
| | (v) *Cynodon dacctylon* | African star | Annual early flowering |
| | *(vi) Digitaria decumbens* | Wolly finger grass | perennial flowering |
| | *(vii) Sporobolus pyramidalis* | Pyramid drop grass | Annual late flowering |
| | (viii) *Penisetum Polstrachum* | (Mission grass) | Annual late flowering |
| | (ix) *Penisetum purpureum* | (elephant grass) | Perennial late flowering |
| B. | Legumes and other browse plant and crops | | |
| (i) | *Calopognium muconoides* | (Calapo) | Annual late flowering |
| | *Centrosema pubescens* | (Centro) | perennial late flowering |
| | *Impoma batata* | (Sweet potatoes) | Leaves/stems |
| | *Manihot spp* | (leaves) | Leaves/browsed |
| | *Carica papaya* | (paw paw) | leaves/browse |
| | *Leucarna leucocephala* | (Lucaena) | Leave/bark |
| | *Gmellina arboris* | (leaves) | Bark soft stem |
| C. | Concentrate feeds/feed stuffs | | |
| (i) | Poultry Growers mash | (15%cp; 2,650Kcal/Kg ME) | |
| (ii) | Barbara nut chaff (dusa) | | |
| (iii) | Crushed maize | (17.0% Cp; M.E | |
| (iv) | Salt (common salt) | (8.80% Ras | |
| (v) | Crushed and roasted full fat soya bean? | | |

*Nutrient composition sourced from The Nutritional Laboratory EBSU, Abakaliki (Otuma, 2003)*

**Table 2:** Breeding Designs) programmes for the experiment

| Breed of goat | mating patterns |
|---|---|
| Pure crosses | WADG x WADG of savannah ecozone |
| Main crosses | ADG x RSG = $F_1$) |
| Reciprocal crosses | RSG x WADG |
| $F_2$ backcrosses | RSG x $F_1$ (RSG x WADG) |
| Pure crosses | RSG x RSG of Sahel origin |

SG = Red Sokoto Goat, WADG = West African Dwarf Goat,
Pure Crosses = the same line/strain

**Table 3:** Means ± SE for body weight (kg) of five genotypes of goats reared in four seasons (Aged 8 weeks): Genotype by season effect

| Genotypes | Seasons | | | | Genotype Mean ± SE |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| WADG x WADG | 4.07±0.33$^b$ | 3.85±0.22$^a$ | 3.44±0.6$^a$ | 3.47±0.05$^a$ | 3.71±0.17$^a$ |
| WADG x RSG | 5.99±0.15$^b$ | 6. 05±0.15$^b$ | 5.24±0.12$^b$ | 5.59±0.13$^b$ | 5.72±0.14$^b$ |
| RSG x $F_1$ (RSG x WADG) | 10.26±0.02$^c$ | 11.21±0.40$^c$ | 10.91±0.35$^c$ | 5.46± 0.34 | 11.96±0.53$^c$ |
| RSG x WADG | 7.13 ±0.87$^b$ | 6.60±0.15$^b$ | 6.13±0.18$^b$ | 6.09±0.17$^b$ | 6.49±0.53$^b$ |
| RSG x RSG (sahel) | 3.14±0.49$^a$ | 4.67±17$^b$ | 4.34±0.18$^b$ | 4.81±0.16$^b$ | 4.26±0.24$^a$ |
| Overall seasons means±SE | 6.14±0.49$^a$ | 6.46±0.22$^b$ | .02±0.14$^a$ | 6.16±0.16$^a$ | |

*a, b, c. Means within the same row (overall seasonal having different superscripts are significantly different (P<0.05) While means in the same column (overall genotype) with different superscripts are (P<0.05) significantly different (P< 0.05)*

**Table 4:** Means ± SE for the height-at withers (cm) of five genotypes (Aged 8 weeks) reared in four seasons

| Genotypes | Seasons | | | | Genotype Mean ± SE |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| WADG x WADG | 20.90±0.29 | 20.46±0.30 | 20.91±0.18 | 21.18±0.15 | 321. 51±0.23$^a$ |
| WADG x RSG | 30.44±0.12 | 30.85±0.61 | 30.80±0.21 | 31.46±0.11 | 31.55±0.25$^b$ |
| RSG x $F_1$ (RSG x WADG) | 32.48±0.38 | 3249±0.51 | 33.60±0.31 | 32.01±0.29 | 32.84±0.51$^b$ |
| RSG x WADG | 30.42±0.38 | 31.60±0.33 | 31.54±0.36 | 31.55±0.48 | 31.58±0.18$^b$ |
| RSG x RSG | 34.13±0.48 | 34.36±0.49 | 34.64±0.31 | 34.48±0.36 | 34.51±0.66$^c$ |

*a,b,c* =means in the same columns for overall genotypes having different superscripts one significantly different P<.0.05) while means in the same row for seasons with different superscripts are significantly different (P< 0.05).

**Table 5:** Means ± Se for body length (cm) for five goat genotypes reared in four seasons (Aged 8 weeks) for genotypes x & season effect).

| Genotypes | Seasons | | | | Genotype Mean ± SE |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| WADG x WADG | 25.36±0.23 | 25.41±0.59 | 26.42±0.31 | 25.16±0.30 | 25.71±0.26$^a$ |
| WADG x RSG | 35.48±0.37 | 36.54±0.66 | 36.41±0.30 | 35.11±0.23 | 35.47±0.38$^b$ |
| RSG x $F_1$ (RSG x WADG) | 40.13±0.51 | 40.62±0.39 | 40.30±0.22 | 40.61±0.43 | 40.61±0.43$^c$ |
| RSG x WADG | 35.49±0.05 | 35.13±0.30 | 35.48±0.36 | 35.47±0.11 | 35.70±0.48$^b$ |
| RSG x RSG | 40.51±0.60 | 40.52±0.58 | 41.42±0.61 | 41.13±0.63 | 41.13±0.61$^c$ |

*a,b,c* = Means in the same columns with different superscripts are significantly different (P< 0.05) while means in the same row for seasons with different superscripts are significantly different (P<0.05).

greatest-growth. The significant effects of breeds and season on the weight of the goats indicate that the two factors are integral to each other for genetic improvement of Nigerian goats. The however, agreed with the observations of Hass (1978); and Das *et al.* (1994) who reported on the positive effect, of season on the crosses of boer goat of indigenous small East African goats in Kenya. Pre-weaning age is a period of rapid growth (early growth phases) in the skeletal and muscular systems of animals in order to meet up with the stresses of muscle mass (Trekkle and Marple, 1983). The highest increase in body weight recorded by RSG x Fi in this study cou Table 4: Means ± SE for the height-at withers cm) of five genotypes (Aged weeks) named in four seasons ld be attributed to the effect of additive genes arising from the effect of crossing. Nwakpu and Omeje (2004), Das et al. (1994), Nwakalor and Ubochi (2002) respectively recorded a similar result on effect of crossing in pigs, goats and sheeps. The findings did not agree with Das (1989), who reported that the growth rate of kids after weaning is partly determined by the genetic potentials of the kids and its environment. Similarly, Peart (1982) associated high pre-weaning weight with the ennhanced environment of the mother's womb as well as the inherent growth potential of the animals.

The variation in weights due to differences in seasons of rearing could be explained by variations in amount of annual rainfall, which in turn influenced pasture production, quality and its availability. The high growth could also be attributed to the fact that prior to weaning; kids depend largely on mother's milk as food, the production of which is directly related to the quantity and quality of pasture as reported by Mukudan and Bhat (1983). However, the results obtained by Shelby *et. al.*, (1963) and Eltawil *et al.* (1970) on effect of season on birth weight of sheep varied with the present findings. Improvement of height-at-withers and body length indicated by the crosses demonstrated the (heterotic effects) the transfer of genes by the parents of the kids. This is in line with the aim for crossbreeding of distantly related strains as reported by Wilson (1981), Mitton (1993), Charlesworth and Charlesworth (1999). The general aim of evaluation of the effect of different cross breeding programmes and seasonal variations on growth is to obtain the best breeding option for Nigeria goats. A breed combination of RSG x F1 (RSG x WADG) and the rearing (July – September) seasons respectively should be maintained to enhance early productivity, followed by the reciprocal cross breeding programmes

## 5. Conclusion and Application

Crossbreeding programme and variations in season of rearing have resulted in achieving genetic changes for Nigeria: goats. The genes brought into the kids from parents have introduced genetic variability for fast weaning of kids. It also indicates that our indigenous goats have great potentialities for growth. Growth weights was best achieved between April – June while the RSG x $F_1$ (backcross) genotype achieved best performance.

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