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THE EFFECTS OF SEASONS OF BIRTH ON BODY AND TESTIS GROWTH OF LARGE WHITE AND LARGE WHITE X IND F_1 CROSSBRED BOARS IN A HUMID TROPICAL ENVIRONMENT

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ABSTRACT

This study was conducted to find out the effects of season of birth (SOB) on body and testis growth in the Large White (LW) and Large White x Indigenous (LWXIND F_1) crossbred boars in a humid tropical environment. 21 weaner boars of each genotype born in the Dry season (DS) and rainy season (RS) were used and their body and testis growth monitored by determining body weight and linear body and testis measurements at regular intervals from 8-36 weeks of age. The results obtained showed significant effects ($P<0.05$) of season of birth (SOB) on body weight, feed intake, feed/gain and linear body measurements of LW boars but no significant ($P>0.5$) effects of SOB on these traits in the crossbreds. The Genotype x SOB interaction effects on body weight were significant ($P<0.05$). Also, all testis measurements were significantly ($P<0.5$) affected by SOB in both LW and LW x IND F_1 boars. The interaction effects (Genotype x SOB) on testis measurements were significant ($P<0.05$). These results indicate that body growth in LW boars is sensitive to elevated environmental temperature that characterizes the dry season in tropical climate, while the crossbred boars are resistant to such condition. The results also showed that boars of both genotypes reared in the DS had lower testis growth than those reared in RS which results may have far-reaching implications on the reproductive performance of boars in this climate.

Key words: Season, testis, boars, growth, humid tropics.

INTRODUCTION

One of the major reasons for introducing the improved breeds of pigs into Nigeria was to facilitate the up-grading of the productive qualities of the local genotypes of pigs by cross breeding (Okwun *et al.*, 1996). This is aimed at stemming the variations in meat output among the genetically improved exotic breeds and the largely un-improved indigenous types arising from differences in their growth rates, mature body sizes and reproductive potentials (Adebambo and Onakade, 1983; Steinbach, 1985). Whereas the genetically improved exotic breeds may be useful in upgrading the productive qualities of the indigenous types, the indigenous types which are reputed for their tolerance to trypanosomosis may be useful in stabilizing the more vulnerable exotic breeds. The resultant crossbreds tend to become more trypanotolerant

than their exotic parent exhibiting higher growth rates and attaining larger mature body size than the pure indigenous types.

Available reports (Wettemann and Bazer, 1985; Connor and Orzechowski, 2001) indicate that pigs generally are susceptible to environmental stress notably elevated environmental temperatures. The impact of elevated ambient temperature, obtainable at certain seasons of the year in both temperate and tropical climates may be direct as a result of increased body temperature or compensatory changes in blood flow (Connor and Orzechowski, 2001) or it may be indirect, through the hypothalamus, involving changes in appetite/feed intake, body metabolism and subsequently the rates and efficiency of weight gain. Studies conducted in temperate climate indicate reduced rate of growth in boars during the summer months mainly as a result of depressed efficiency of feed utilization (Close and Mount, 1978, Stahl and Cromwell, 1979). Also, young boars exposed to temperatures between 31^{0}C and 34.5^{0}C for 90 days had lower rates of testicular growth, with testis weight decreasing by 38g (Wettemann and Desjardins, 1979). Such boars tend to have lower testis size at maturity producing lower sperm numbers than their counterparts placed under controlled environment. Unfortunately, very few scientific reports exist on growth and reproductive performance of pigs reared in the tropical climates where day temperatures may rise to more than 35^{0}C at certain times of the year. The present study was designed to determine the effects of tropical seasons on body and testis growth of Large White and large White x indigenous F_1 boars in a humid tropical environment.

MATERIALS AND METHODS

Location of the study

This study was conducted in the piggery unit of the Department of Animal Production and Fisheries of Enugu State University of Science and Technology Abakaliki from April 1996 to June 1998. Abakaliki is a typical humid tropical climate with two predominant seasons, the rainy (April to October) and dry (November to March). During the hottest period of the year (February – March) the day temperature ranges from 31 – 36^{0}C with an average value of 34^{0}C while in the coolest period (July to August the day temperature ranges from 24 – 28^{0}C with an average of about 26^{0}C. The average relative humidity for the corresponding periods are 70% and 85% respectively.

The Animals

The males of the two genotypes of pigs, Large White (LW) and Large While x Indigenous (LW x IND) pigs were used. The LW boars were the progeny of the elite breeding stock owned by Enugu State Ministry of Agriculture and Natural Resources while the LW x IND boars were the F_1 generation of the Large White and indigenous crossbreeding programme of Animal Production and Fisheries Department.

A total of 21 healthy male pigs of each genotype were respectively selected at weaning from litters born in the rainy season and dry season. The dry season born pigs were farrowed in the first week of February and weaned in the first week of April (56days post partum). Their weaning weights ranged from 8.15 – 13.35 kg for the LW and 7.80 – 11.20kg for the crossbreds. The rainy season born pigs were farrowed within the first two weeks in September and also weaned after 56 days post partum. Their weaning weights ranged from 8.20 – 12.15kg for LW and 7.15 – 10.30kg for LW x IND F_1 crossbreds. All the

male pigs used were thoroughly checked for body and testicular defects prior to selection at weaning. Animals within each season of birth were replicated three times with 7 animals per replicate in a pen measuring 3 x 4 meters. The experiment was a 2x2 factorial study involving two seasons of birth and 2 genotypes of pig.

Duration of Study and Management of Animals

Following the selection of the experimental animals, a pre-experimental period of one week was allowed for each group (rainy season and dry season groups). This was to ensure that all animals overcame the weaning stress and get used to themselves in their new accommodation. Thereafter, they were respectively reared until 36 weeks of age. Thus, the dry season boars were reared from the second week of April till the third week in December while the rainy season born boars were reared from the third week in October till the last week of June. The duration of the experiment was deliberately prolonged to ensure that the animals exhausted their period of active growth. All the animals were subjected to intensive management throughout the study. The pens had solid dwarf walls and concrete floors and were insect-proofed using wire netting. All animals were de-wormed in the second day of the pre-experimental period with injectable anti helminthic. They were also given appropriate doses of injectable multi-vitamins. All the experimental animals were again dewormed at 22 weeks of age. All the animals were fed *ad lib* with diet containing 20% crude protein. Based on earlier studies *ad lib* ration was taken as 4% of the animal's body weight (Omeje, 1995) determined at two week intervals. Water was also provided *ad libitum*.

Measurements

Daily feed intake was determined as the difference between amount of feed fed and the amount left over in 24 hrs while feed conversion ratio was determined as ratio of feed intake and weight gain. Body measurements were carried out on all the animals at two-week intervals from 8 – 36 weeks of age. The measurement taken at 8 weeks of age was regarded as day 0. Body growth was monitored by measuring body weight (BW), Body length (BL), Height at shoulder (HS) and Heart girth (HG). Body weight was determined with the Avery weighing scale and recorded in kg while linear body measurements were taken using meter rule (for HS) and cloth tape (for HG and BL). HS was taken as the vertical distance from the floor of the restraining cage to the highest point on the shoulder while BL was measured as the distance from the highest point of withers to the base of the tail (Lefaucheur *et al* 1991). Heart girth was measured as the circumference of the chest region with the tape passing behind the forelimb, barely in contact with the body without depressing the skin. All linear measurements were recorded in centimetre.

Tests measurement

Starting from 12 weeks of age and at four week intervals (12, 16, 20, 24, 28, 32 and 36 weeks of age), two boars were randomly selected from each genotype within season of birth and castrated. A total of 14 boars were castrated in each genotype per season of birth. After separating the epididymis, the wet weights of both testis (left and right) were obtained using a sensitive balance and recorded in kg. At the same time, the testis length (TL), testis width (TW) and testis circumference (TC) were determined according to the procedures described by Schinckel et al. (1983). TL was measured with vernier calipers as the length of the major axis of the testis.

TW was measured by adjusting the calipers to span the minor axis of each testis at the point of maximum width TC was measured by placing the cloth tape around the middle of the testis at its point of maximum width. All linear measurements of the testis were recorded in cm.

Statistical Analysis

The Harvey's least square means and standard errors of the means were calculated for each parameter. The data collected from the study were subjected to the least square analysis of variance (Harvey, 1990). The t-test analysis was used to determine the differences in body and testicular measurements between seasons of birth within genotype. Means separation was by new Duncan's multiple range test according to the procedures of Duncan (1955).

RESULTS AND DISCUSSION

The least square (LS) means for body weight (kg), feed intake (kg) and feed/gain (kg) of the two genotypes of boars born in the Dry season (DS) and rainy season (RS) are presented in Table 1 while the least square means for linear body measurements are presented in Table 2.

Table 1. Least square means ± SEM of Body weight, Feed intake and Feed/ gain of two genotypes of boars born during the Dry season (DS) and Rainy season (RS)

Parameters	Large white		Crossbreds.	
	DS	RS	DS	RS
(i) Body weight (kg)				
Initial Body weight	8.96±0.37	8.51±0.31	7.47±0.29	7.35±0.27
Final body weight	93.30±0.68[a]	83.60±0.62[b]	77.11±0.80[c]	70.83±0.69[c]
Average daily gain (8-12 week)	0.42±0.13	0.39±0.10	0.38±0.16	0.36±0.12
Average daily gain (12-36wks)	0.58±0.21[a]	0.50±0.18[b]	0.47±0.15[c]	0.44±0.10[c]
Genotype X SOB Means	73.67±2.45[a]		68.0±1.87[b]	
(ii) Feed intake (kg)				
Feed intake (8-12 wks)	1.15±0.23	1.10±0.09	1.08±0.15	1.04±0.13
Feed intake (12- 36 wks)	2.30±0.52[a]	2.12±0.26[b]	2.18±0.20[c]	2.10±0.21[c]
(iii) Feed/ Gain				
Feed / gain (8 –12wks)	2.74±0.24	2,82±0.27	2.84±0.18	2.89±0.22
Feed / gain (12-36wks)	3.96±0.38[a]	4.22±0.42[b]	4.64±0.50[c]	4.11±0.39[c]

[a, b, c] Means in a row with different superscripts within and between genotype are different (P<0.05)

Table 2. Least square means ± SEM for effect of season of birth on Body length, Height at shoulder and Heart girth in two genotypes of boars.

Parameters	Large white		Crossbreds.	
	DS	RS	DS	RS
Initial Body length (cm)	34.85±1.63	34.20±1.41	32.61±1.06	34.27±1.17
Final body length (cm)	118.45±0.96[a]	110.50±1.24[b]	98.45±0.98[c]	95.26±0.86[c]
Av. Gain in body length (cm)	0.43±0.31[a]	0.38±0.18[b]	0.35±0.18[c]	0.31±0.16[c]
Initial height at shoulder (cm)	32.34±1.16	32.26±0.98	29.25±0.89	27.10±0.19
Final height at shoulder (cm)	86.26±1.62[a]	81.22±1.15[b]	75.17±0.90[c]	70.84±1.10[c]
Av. Gain in height at shoulder (cm)	0.28±0.15[a]	0.24±0.18[b]	0.23±0.09[c]	0.22±0.18[c]
Initial heart girth (cm)	39.04±1.12	38.81±0.96	37.25±0.76	35.16±0.65
Final heart girth (cm)	98.49±1.36[a]	93.71±0.48[b]	88.09±0.88[c]	82.50±0.77[c]
Av. Gain in heart grith (cm)	0.30±0.22	0.28±0.12	0.26±0.76	0.24±0.28

[a, b, c] Means in a row with different superscripts within and between genotype are different (P<0.05)

The analysis indicated significant effects ($P< 0.05$) of season of birth (SOB) on body weight (BW) and average daily gain (kg) at growing –finishing stage (12-36 weeks). The genotype X SOB interaction effects were also significant ($P<0.05$). A similar trend was exhibited in Table 2 showing the LS means of linear body measurements of the boars during the seasons. SOB had no significant effect ($P < 0.05$) on body weight and linear body measurements in the LW x IND F_1 crossbreds. The significant effect of SOB on body growth in the LW may be the result of the prevailing condition in the season within which they were reared. For instance, the DS-born boars were farrowed in late dry season (February) and reared through the rainy season when the environmental temperatures are relatively lower. In this season, solar radiation intensity is often greatly reduced owing to frequent overcasts by rain-bearing clouds (Alaku, and Steinbach, 1982). The RS – born boars were farrowed in late rainy season (September) and reared through the dry season which except for the months of December and January (Harmattan period) is generally hot especially in the months of February and March which are known as the hottest months of the year in the humid tropics. In the greater part of this season, air temperature may rise as high as 35^0C in the day and fall to around 24^0C in the night (Steinbach, 1977). These two rearing conditions had differential effects on the boars due to the synergistic effects of temperature and relative humidity such that the RS-born boars consistently had higher final body weights and linear body measurements at the growing –finishing phase (12-36 wks) than the DS- born boars at the same age range. These results corroborate the earlier findings by Alaku (1978) that in southern Nigeria with typical humid tropical climate, pigs born from February to March and from November to December consistently had higher body weights than those born in other periods. The present results also showed that the post weaning (8-12 weeks) growth of boars was not significantly affected by SOB even though pigs born in DS had slightly higher average rates of gain (0.42 kg) than the RS-born boars (0.39kg). This is probably because at that stage of growth, the prevailing temperatures in both seasons are well within their zone of thermal comfort (Serres, 1992). However, as the body weights of boars increased with age, the lower critical temperature tended to decrease (Serres, 1992) such that the pigs became more prone to thermal discomfort. In this study, boars (RS-born) exposed to high ambient temperature at the growing-finishing phase experienced thermal distress resulting in reduced performance. Andrews *et al.* (1960) reported that in temperate climate, high solar radiation experienced in the summer results in high ambient temperatures such that pigs reared even under shade have increased respiratory rate, increased rectal temperatures and lowered feed intake/ efficiency and would require such ameliorating measures like wallows, fans and water sprays to encourage evaporative heat loss and maintain normal growth rates. In this study, RS-born boars had significantly lower feed intake (2.12kg) and feed/gain (4.22kg) than DS born boars with feed intake of 2.30kg and feed /gain of 3.96 kg. These observation were in line with those of Yates (2004) who reported that decreased appetite/feed intake and poor feed efficiency are indirect effects of thermal discomfort in growing animals.

The significant genotype x SOB interaction effects and the lack of significant influence of season of birth on all growth parameters in the crossbreds are rather noteworthy. Even though the

LW boars had significantly higher genotype x SOB mean than the crossbreds, suggesting better performance in the LW than the crossbreds at all seasons, the crossbreds evidently exhibited considerable improvement in body weight than the indigenous parent. This genotype also appeared to have resisted the characteristic harsh environmental condition of the humid tropics more than the LW. These traits may be useful in developing genetic lines for successful large scale out-door rearing of pigs in the humid tropics. The LS means for the effect of SOB on testis weight and linear testis measurements are presented in Table 3.

Table 3. Least square means ± SE for Testis weight (g) and Testis measurements (cm) in two genotypes of boars during Dry and Rainy seasons

Parameters	Large White		Crossbreds.	
	DS	RS	DS	RS
Initial paired testis wt. (g)	29.80±1.97	26.60±1.40	23.40±1.45	20.60±1.03
Final paired testis wt. (g)	326.07±5.17[a]	295.90±4.08[b]	269.85±5.17[c]	242.40±4.06[d]
Genotype X SOB	285.60±4.18[a]		279.64±3.86[b]	
Initial testis length(cm)	5.15±0.05	4.38±0.08	4.96±0.09	4.25±0.07
Final testis length (cm)	12.97±0.20[a]	11.38±0.22[b]	11.01± 0.30[c]	10.15±0.21[d]
Genotype X SOB	9.40±0.18[a]		8.03±0.15[b]	
Initial testis width (cm)	3.25±0.07	3.10±0.05	2.91±0.10	2.47±0.08
Final testis width (cm)	6.47±0.22[a]	5.43±0.26[b]	6.21±0.17[c]	5.32±0.14[d]
Genotype X SOB	4.92±0.12[a]		4.43±0.12[b]	
Initial testis circumference (cm)	10.95±0.15	10.25±0.20	9.12±0.17	8.25±0.19
Final testis circumferences (cm)	19.85±0.19	18.55±0.24	18.24±0.20	16.59±0.25
Genotype X SOB	15.56±0.23[a]		13.57±0.22[b]	

a, b,c,d. Row means within genotype and between genotype with different superscript are different ($P<0.05$)

The results indicate significant effects of SOB on testis growth in both genotypes of boars. In all the cases, the DS-born boars had higher values for all the parameters than RS-born boars. The genotype x SOB means were also significantly ($P<0.05$) different with higher values recorded for the Large White than the crossbreds. The observed effects may likely be the result of prolonged exposure of the boars to differential effects of varying ambient temperatures between seasons. Most studies on the effects of elevated temperatures on testis development involved scrotal insulation (McNitt *et al*, 1972; Stone, 1982; Malmgren 1993) for varying periods of time. Even at that, there appears to be considerable variations in the results obtained by various authors. For instance, Malmagren (1993) did not observe any significant differences in testicular growth of pre-pubertal boars (100days of age) whose scrotum were insulated for 100 hours to obtain a testis temperature of 34^0C to 36.7^0C. Wettemann *et al*. (1976) and Wettemann and Desjardins (1979) observed that paired testis weight decreased by 38g in young boars exposed to temperatures

between 31^0C to 34.5^0C for 90 days. The later report involving exposure of whole body to elevated temperatures appears to be more related to the conditions adopted in the present study than the former which involved localized heating of the testis.

CONCLUSIONS

The result of the present study has shown that the LW boars exhibited significantly reduced growth when reared in the dry season than rainy season. The crossbred boars (LW X IND F_1) were much more resistant to the prevailing condition of the tropical seasons than the LW. Testis growth in both boars were affected by season with young boars reared in the rainy season exhibiting better growth and having larger testis than those reared during the dry season. These results may be useful in managing the growth and reproductive performance of boars in this climate.

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