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Effects of some non-genetic factors on growth rate of tropical cattle in Nigeria.

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Abstract

Data on 1,962 bulls purchased on cattle routes, and fed on pasture for slaughter were anlysed for effects of period of start of feeding, initial weight and age at the start of grazing. Results showed that period of start of grazing had a significant effect, with bulls coming in late in the rainy and early in the dry seasons showing superior growth rate over the first three months and six months, compared with those brought in at other times. Effects of age and weight at time of start of feeding were also highly significant. Least squares means for growth rate over the first three months and the first six months were 130g and 220g respectively. It is suggested that improved pasture management, and supplementary feeding particularly in the dry and early rainy seasons are essential for improvement of growth performance.

Introduction

Post weaning growth rate is one of the most important production traits of beef cattle, affecting the length of feeding time and economy of production. Swiger *et al.*, (1963), Brinks *et al. (1962),* Vogt *et al.*, (1967) and Dinkel *et. al.*, (1968) among others, have reported on genetic factors affecting post weaning growth rate of European breeds of cattle in the temperate region. Schalles and Marlowe (1967) and Marlowe *et al.* (1965) also reported significant effects of non-genetic factors such as age of calf, age of dam year of test and weight at the beginning of feeding on post-weaning growth rate. Similar investigations in the tropics have been reported. Sacker *et al.* (1971) studied growth rate of Angus, Boran, Red Poll Ankole and their crosses. They reported that age of dam had no significant effect on growth, but period and year of birth as well as sex of calf had significant effects on growth at different ages. Improved body weight gains were reported by Kidner (1966), Rodel and Boultwood (1967) and Bembridge (1971) who attributed the gains to improved pasture management, protein supplementation of pasture and range grazing. Season of birth was

found to have no effect on growth rate but affected live weight gains of Ndama and Keteku cattle on derived Guinea savanna range (Hill and Upton, 1964).

Information on non-genetic factors are required for adequate planning of beef cattle fattening operations and for adjusting data needed for evaluation of breeding stock. The following analysis was carried out to estimate the effects of period of start feeding, initial age and weight on growth rate of beef bulls.

Materials and Methods

Data were collected on 1,962 bulls purchased on cattle routes in 1970 and 1971 for finishing on pastures at Mokwa cattle ranch. The bulls comprised various zebu breeds and crosses which varied in age from 15 to 48 months at the time of purchase. Their weights ranged from 123 to 284kg. The age of each bull was determined by examining the dentition according to the observation of Williamson and Payne (1965) that the eruption of the first, second, third and fourth pairs of incisors takes place at approximately 28, 34, 41 and 45 months of age respectively.

On the day of arrival at the ranch, bulls were given rinderpest, anthrax and contagious bovine pleuropneumonia (CBPP) vaccines. Blood and faecal samples, and the body weight of each animal were taken. One week after arrival, the bulls were given samorin as prophylactic treatment for trypanosomiasis, and treated for liver fluke if found to be 25 percent positive from examination of faecal sample. They were sprayed against ticks every two weeks and their body weights were taken every four weeks. Period of quarantine was four weeks from data of arrival. CBPP vaccination and samorin were repeated at six weeks and thereafter, samorin was given every six weeks.

Animals were grazed on grass pastures of *Panicum maximum* and *Andropogon gayanus* interplanted with *Stylosanthes gracilis* at a stocking rate of about 1.6 hectares per head. They were supplemented with about 1 kg whole cottonseed per head daily throughout the year. During the dry season which starts in November, bulls were fed corn silage ad libitum, in addition to cottonseed. Body weight was taken every four weeks.

A least squares analysis of data with unequal subclass numbers (Harvey, 1960) was carried out to determine the effects of age and weight at the start of grazing, and the period of year when grazing commenced. Age of bulls was classified into four groups as follows:

18 months or younger, 19 to 24 months, 25 to 30 months and 31 months or older. Initial weight was the weight in kg when the animal was brought into the ranch. Time of start of grazing consisted of six two-months periods corresponding to early, mid and late rainy season, and early, mid and late dry season. Period one was April–May, and period six was February – March. Animals were brought in continuously throughout the seasons and those that arrived in the three periods corresponding to the wet season months, spent varying amounts of time on wet and dry season pastures. The same was true for animals brought in during the dry season months.

The two dependent variables were average daily gain during the first three months (3-month ADG) and average daily gain in the first six months of feeding (6 month ADG).

The model used is as follows:

$$Y_{ijk} = u + P_i + A_j + PA(ij) + (X_{ijk} - x) + e_{ijk}.$$

where Y_{ijk} = The measurement on the k^{th} individual of the j^{th} age group, started on feed in the i^{th} period.

u = overall mean.

P_i = the effect of i^{th} period of start of feeding.

A_j = the effect of the j^{th} age group.

$PA_{(ij)}$ = the interaction effect.

X_{ijk} = the independent continuous variable, initial weight of bull.

x = the arithmetic mean of the independent continuous variable.

e_{ijk} = the random error common to each bull and assumed to be normally and independently distributed with a mean zero and variance.

e_{ijk} = the random error common to each bull and assumed to be normally and independently distributed with a mean zero and variance.

In the analysis on the dependent variable 3-month ADG, the interaction term was left out of the model because some of the age group/period combinations had no observations.

The normal least squares equations were solved to obtain estimates of constants, regression coefficients (b) and standard errors by in-

version of matrix on IBM 370. The restriction imposed was that the sum of the subset constants equals zero. T-tests were performed to determine significant differences between pairs of constants within each subclass.

Results and Discussion

The arithmetic means of 3-month ADG and 6-month ADG based on subclassifications of main effects are shown in Table 1. The relevant portion of the analysis of variance is shown in Table 2 for the two dependent variables. Table 3 shows the least squares means for 3-month ADG and 6-month ADG, the least squares constants and their standard errors, as well as the result of t-tests for significant differences between constants within the same subclasses, in alphabetic code.

TABLE 1 – ARITHMETIC MEANS OF 3–MONTH AND 6–MONTH ADG AND THEIR STANDARD ERRORS FOR SUBCLASSIFICATIONS OF PERIOD AND AGE GROUPS WITH RESPECT TO ANIMALS HAVING BOTH RECORDS.

Subclass	*No. of observations*	*6-month ADG (g) ± S.E.*	*3-month ADG (g) ± S.E.*
April - May	114	154.65 ± 11.5	129.76 ± 16.0
June - July	172	198.37 ± 9.4	196.69 ± 13.1
Aug. - Sept.	472	164.51 ± 5.7	119.12 ± 7.9
Oct. - Nov.	67	346.48 ± 15.0	264.73 ± 20.9
18 months or less	436	191.66 ± 5.9	153.90 ± 8.2
19 - 24 months	211	168.75 ± 8.5	108.79 ± 11.8
25 - 30 months	111	181.97 ± 11.6	174.57 ± 16.3
31 months or more	67	197.64 ± 15.0	196.27 ± 20.9
Overall Mean	825	184.99 ± 4.3	148.59 ± 6.0

TABLE 2 – LEAST SQUARES ANALYSIS OF VARIANCE OF THE EFFECT OF MAIN FACTORS ON THE DEPENDENT VARIABLES, 3–MONTH AND 6–MONTH ANERAGE DAILY GAIN.

		6-month ADG		*3-month ADG*
Source	*d.f.*	*Mean Square*	*d.f.*	*Mean Square*
Period	4	68498.2**	3	512362.5**
Age Group	3	52140.3*	3	98573.7*
Period x Age	12	56563.3*	-	—
Regression	1	134458.1*	1	49567.0
Error	1941	15059.4	817	29304.6

** = significant (P < .01)
* = significant (P < .05)

TABLE 3 – LEAST SQUARES MEANS, DEVIATIONS FROM LEAST SQUARES MEANS, THEIR STANDARD ERRORS, AND THE RESULT OF T–TEST FOR DIFFERENCES WITHIN SUBCLASSES.

	6-month ADG[1] (± S.E.)	*3-month ADG*[1] (± S.E.)
Mean	229.17	130.00
Periods		
April - May	-19.85 ± 11.1[a]	- 49.7 ± 15.9[a]
June - July	- 12.33 ± 8.8[a]	7.61 ± 12.7[c]
Aug. - Sept.	6.73 ± 11.7[a]	- 53.0 ± 10.4[b]
Oct. - Nov.	52.79 ± 14.8[b]	95.0 ± 17.8[b]
Dec. - Jan.	- 27.34 ± 24.3[a]	—
Age Group		
18 months or less	7.20 ± 9.4[a]	3.66 ± 11.6
19 - 24 months	-11.55 ± 9.2[a]	- 36.98 ± 11.7[b]
25 - 30 months	-4.56 ± 11.9[a]	14.91 ± 15.8[ab]
31 months or more	23.21 ± 9.8[b]	25.73 ± 16.9[cb]
Period x Age	**	—
Regression of initial wt.	0.30 ± 0.1	0.31 ± 0.2

** = Significant (P < .01) — no data

[1]Least squares constants in the same column and the same subclass with at least one common superscript, are not different (P > .05).

Period of start of feeding

Period of start of feeding had a significant effect on both the average daily gain in the first three months and the first six months of feeding. Table 3 shows that 6-month ADG was lowest for animals that were put on range in April–May, June–July and December–January periods. It was highest for animals put on feed in the October – November period which showed a significant gain of 46g over the other periods. With respect to 3-month ADG, lowest gains were made by animals put on pasture in the April–May, and August–September periods. Higher gains were made by animals starting in the June–July and October–November periods, with the gains in the animals coming in during the latter period being significant. Bulls starting in the October–November period gained about 148g more than the lowest group and 88g more than the next best.

The results suggest that bulls put on pasture in the later part of the rainy season and the early dry season under the conditions described, gained faster than those started at any other period of the year. Temperature, relative humidity and precipitation are the most important climatic factors affecting performance of animals in the tropics, through direct effect on the animal and indirectly by affecting the animal's environment. Table 4 shows that maximum temperature

TABLE 4 – MONTHLY RAINFALL, TEMPERATURE AND HUMIDITY, AVERAGED FOR THE YEARS 1970-1972 MOKWA.

Period	*Months*	*Rainfall (mm)*	*Temperature °C*		*Relative Humidity %*
			max.	*Min.*	
1.	April	36.3	37.6	24.6	62.1
	May	124.8	34.8	23.8	70.2
2	June	158.7	32.1	22.1	76.3
	July	178.8	30.8	22.0	80.2
3	Aug.	168.3	30.1	23.2	82.5
	Sept.	206.8	30.7	22.8	83.0
4	Oct.	87.2	32.4	21.0	74.4
	Nov.	0.0	33.1	15.7	54.1
5	Dec.	0.0	34.3	15.4	54.1
	Jan.	0.0	35.3	14.6	40.4
6	Feb.	4.5	37.9	19.5	62.1
	March	13.8	38.3	23.8	48.3

varied between the various periods from 30.1 to 38.3°C. For tropical cattle, the comfort zone is between 10° and 27°C. At 35°C, the thermo-regulatory mechanisms begin to fail (Williamson and Payne, 1965) resulting in a rise in rectal temperature, and a decline in feed intake and growth. Some of the observed differences in growth rates between periods could thus be accounted for by temperature, and also by relative humidity variations since body functions of various cattle breeds are significantly affected by air humidity at ambient temperatures above 24°C (Hertz and Steinhauf, 1978).

The time of onset and amount of rain determine the stages of growth of pasture at various periods, and this is reflected in the quality and quantity of feed available to livestock under field conditions. Rainfall data (Table 4) show that pastures would be at an early stage of growth in period one, and would progressively mature, ripen and dry out in subsequent periods. Ademosun and Kolade (1973) reported that the dry matter content of two varieties of *Cynodon* increased from 30.5 to 60.5 and 28.7 to 60.9 percent respectively for each variety when they were harvested at ages ranging from 28 to 91 days. Crude fibre increased from 28 to 40 percent and crude protein decreased from 12 to 7 percent. Similar observations were reported by Ademosun (1973) on guinea grass, Olubajo (1973) on grasses at Ibadan and Zimmelink (1973) on native grasses in northern Nigeria. Superior performance of the bulls would be partly due to higher dry matter intake from the pasture and silage of the late rainy and early dry seasons, compared to the pasture grazed during the early and mid rainy season. There was a significant period by age group interaction for 6-month ADG.

The least squares means were 130g for growth rate in the first three months and 229g for growth rate in the first six months. At the rate observed in the six month grazing period, only 83.6kg would be gained in 365 days. Kidner (1966) showed that it was possible to finish half-bred Red Poll and Zebu cattle on good pasture at 30 months with final body weight of 454.6kg. Rodel and Boultwood (1967), and Bembridge (1971) reported significant effects of cottonseed supplementation, types of pasture and levels of nitrogen fertilization on weight gains of steers during summer. Also, Adegbola (1969) reported 29 and 114 percent increases in body weight of steers respectively after supplying 22.7 and 45.4 kg nitrogen to natural grassland that was mainly *Andropogon gayanus*. Results of the present study suggest that in order to achieve similar growth performances, feed supply needs to be improved. Body weight gains up to 750 g/head/day has been recorded on feedlot

trials using grass silage or hay plus cottonseed or dried brewer's grain (Neumaier, 1974). Good quality corn silage could be fed during the rainy season to supplement pasture grazing and offset possible loss of body weight which might occur as a result of low nutrient intake during the early rainy season.

Lower gain was made in the first three months of grazing compared to the first six months. This might be due to the fact that the animals had to adjust to a new environment. With observed improvement in the six month period, it is possible that growth rate would be higher over longer grazing periods. A correlation coefficient of 0.56 between early growth rate and growth rate over six months period which does not necessarily represent a cause and effect relationship, indicates that bulls which gained fast in the early grazing period also showed superior perfromance over the entire period.

Age at start of feeding

Age of bulls at time of start ofgrazing had a highly significant effect on rate of gain with respect to both the first three months and first six months of grazing. In the first six months on pasture, three groups of bulls that were 30 months or less did not differ in rate of gains, and made significantly slower gains than bulls that were 31 months or older. Gains made by various groups were less consistent when the first three months was considered. Bulls that were 31 months or older made the fastest gains while those that were between 19 and 24 months at the start of grazing made the slowest gains. Waugh and Marlowe (1969) showed that yearlings (10-13 months calves) had the highest growth rate when two breeds of beef animals were put on full and limited feeding. Schalles and Marlowe (1967) reported that age at start of test had no significant effect, considering all groups and locations, on life time average daily gain, but older bulls showed statistically significant gains on test with respect to group-fed animals on one of the test locations. It appears that the effect of age at the start of feeding is influenced to a large extent by the system of feeding and management both before and during fattening, and this might account for differences in age effects observed.

Initial weight

The weight of bulls at the time they were brought in for grazing had a highly significant effect on growth rate over six months period but had no significant effect on growth in the first three months of feeding. The regression of initial weight on 6-month ADG was -0.30 and indicates that bulls that were heavier at start of feeding gained more slowly than lighter ones. However, the regression of intial weight on gain in the first three months was positive. Thus, the overall superiority of animals that were lighter at the beginning of grazing could be due to compensatory growth in the latter grazing period. This result disagrees with reports by Melton *et al.* (1967) and Akinokun (1968) which indicated that animals with higher initial weight gained faster on test. However, the latter report dealt with yearling animals fed for 196 days in feed lots, compared to older animals fed on pasture in the present study. Furthermore; polynominal regression analysis showed that the relationship between initial weight and rate of gain is curvilinear, and this might further account for the fact that bulls that were 31 months or older had a significantly faster growth rate compared to younger bulls.

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