RELATIONSHIPS AMONG GROWTH CURVE PARAMETERS, WEIGHTS AND REPRODUCTIVE TRAITS IN GUZERA BEEF COWS.

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SUMMARY

Von Bertalanffy nonlinear model was used to fit weight-age data for 575 females Guzerá (Zebu beef cattle) reared under range conditions in southeastern Brazil, to obtain estimates of h^2 and genetic and phenotypic correlation for the relevant growth curve parameters, weights from 240 to 730 days of age and reproductive traits. The (co)variance components were obtained by REML fitting univariate and bivariate animal models. The h^2 estimates in univariate analyses for growth curve parameters A and k were 0.63 and 0.08 respectively, and agreed closely with those of the various bivariate analyses. Genetic and phenotypic correlation between A and k were high and negative. Genetic correlations between observed weights and A and k indicated that selection for weight will reduce maturation rate and improve mature weight, although, phenotypically, heavier animals on ages considered were also early maturing. Correlations among parameters A and k and reproductive traits indicated that heavier and late maturing cows were also sexually late maturing.

INTRODUCTION

Several studies have been carried out to evaluate the usefulness of nonlinear models to describe lifetime growth in beef cattle, and to identify genetic and environmental factors which affect growth curve parameters estimates on *Bos taurus* (Brown et al., 1972a, 1972b; Fitzhugh,1976; DeNise and Brinks, 1985) and *Bos indicus* (Duarte, 1975; Ludwig, 1977; Abassa, 1987). This approach can be helpful in leading to a better understanding of growth process, and in establishing breed growth patterns. Other studies have shown associations between growth curve parameters and reproductive traits, and growth curve parameters and production traits in cows (Marshall et al., 1984; Lopez-de-Torre et al., 1992).

Although there are some reports on nonlinear models to describe growth curve of *Bos indicus* in Brazil, none of them has been carried out with lifetime weight-age data.

The purpose of this study is to fit weight-age data from females Guzerá beef cattle to Von Bertalanffy nonlinear growth curve and to obtain estimates of heritabilities for the relevant growth curve parameters A and k and genetic and phenotypic correlations between those parameters and other economically important traits.

MATERIALS AND METHODS

Data used in this study were obtained in a commercial stud herd located in the State of Minas Gerais in southeastern Brazil. Data were collected from 1961 to 1991 on 575 females Guzerá beef cattle sired by 35 bulls and born between 1961 and 1987. The climate is tropical, with dry season corresponding to fall and winter, lower temperatures occurring in July and August.

All animals in the herd grazed grass pastures all year. Supplement was available only for lactating cows and for heifers during the dry season of some years.

Heifers were first bred when they reached 300 kg. The breeding season has had variable length during the period of this study, and the births occurred practically all the year. Calves were weaned at approximately 8 months of age. Cow weights were recorded every other month from born to 36 months, then every four month and then until cull.

Weight-age data were used to fit Von Bertalanffy nonlinear model,

$$Y_i = A(1 - Be^{-kt_i})^3 + \varepsilon_i ,$$

where Y_i = observed weight at age t_i expressed in months, A = the asymptotic limit of the weight or the average mature weight of the cow, B = integration constant related to initial weights, k = maturing rate, and ε_i = random error.

This model was individually applied to each animal data set. The SAS "NLIN" procedure (SAS, 1988) was used to fit the curve. The Marquardt method, based on Marquardt (1963), was selected. The convergence criterion was

$$(SSE_{i-1} - SSE)/SSE_i + 10^{-6}) < 10^{-8},$$

where SSE_i is the residual sum of squares for the i^{th} iteration.

Other traits considered in this study were observed weights at 240 (W240), 365 (W365), 550 (W550) and 730 (W730) days of age, age at first calving (AFC), first calving interval (CI) and number of calves (NC). Cows born after 1982 were assigned a missing value to NC.

Analyses to estimate variance and covariance components necessary for heritabilities and correlations were carried out by REML using a derivative-free algorithm (Meyer, 1991) through appropriate software (Boldman and Van Vleck, 1991; Ferraz, 1992). All analyses fitted an animal model and included all pedigree information available (927 animals). No other random effect was considered. Year and season (dry x wet) of birth were the fixed effects taken into account for all traits. Analyses in this study were carried out for one or two traits at a time, not to exceed computational disposability.

RESULTS AND DISCUSSION

Only four cows did not reach convergence in the iterative procedure. Fifteen other cows were excluded from analyses for having high parameter variances. The convergence was reached at an average of 9.08 iterations; R^2 average 98.92% and average residual mean square was 209.21 Kg. Mean of parameter estimates for the remainding 556 cows were 454.93 Kg; 0.5685 and 0.07182 for A, B and k, respectively. Standard deviation for the same figure were 49.32 Kg; 0.06935 and 0.01761. Table 1 summarizes simple statistics for weights and reproductive traits.

Table 1 - Simple statistic for weights (Kg) and reproductive (days or number of calves) traits.

Trait	W240	W365	W550	W730	AFC	CI	NC
N	566	569	569	569	493	485	481
S.D.	27.74	34.46	41.63	53.87	135.84	131.07	2.94
Mean	159.24	202.44	256.68	314.01	1165.17	544.78	5.48

Genetic and environmental variances and heritabilities from univariate analyses for all traits were summarized on Table 2. In general, there was a very close agreement between estimates from uni and bivariate analyses. The results are usually consistent with those of literature, but the k parameter showed a very low genetic variance and heritability.

Table 2 - Genetic and environmental variances and heritability from univariate analyses.

Trait	A	k	W240	W365	W550	W730	AFC	CI	NC
$\sigma^2 g$	1474.18	.0000173	147.03	77.79	183.52	328.97	3611.85	786.46	1.42
$\sigma^2 e$	888.73	.0001781	391.88	447.11	720.59	1004.42	8386.99	15714.75	6.15
h^2	.62	.09	.27	.15	.20	.31	.30	.05	.19

Estimates of genetic and phenotypic correlations among growth traits (Table 3) showed strong associations among the weights at various ages, as one could expect. Selection for weight at any age considered will increase mature weight and decrease rate of maturing. Nonetheless, phenotypic correlation between observed weights and k were positive. These results, in the scope considered, are similar to those found by Brown et al. (1972a, 1972b) for Hereford cattle and by Abassa (1987) for Zebu Gobra, and indicates that selection would be an inefficient means of altering the shape of growth curve also, in Guzerá cattle.

Table 3 - Genetic (above diagonal) and phenotypic (below diagonal) correlations.

Trait	A	k	W240	W365	W550	W730
A	–	-.87	.61	.93	.89	.88
k	-.42	–	-.64	.65	-.70	-.60
W240	.17	.13	–	.73	.75	.34
W365	.31	.33	.57	–	.95	.95
W550	.38	.39	.60	.66	–	.82
W730	.44	.47	.34	.69	.41	–

Correlations between growth curve parameters and reproductive traits (Table 4) indicates that cows with heavier mature weights and lower maturing,rates, in spite of reaching weight to breed early, are also sexually late maturing. Mature heavier cows tended to be culled later, and to have smaller first calving interval. Early maturing was also genetically correlated with high NC and small CI, but the low values of heritabilities for these traits reduce the importance of that association.

Table 4 - Genetic and phenotypic correlation.

	Genetic			Phenotypic		
Trait	AFC	CI	NC	AFC	CI	NC
A	.27	-.53	.34	.17	-.17	.24
k	-.67	.48	.52	-.44	-.13	-.04

The phenotypic correlation showed results different from those of Lopez de Torre et. al. (1992) for Retinta cows. Mature heavier cows tended to be more efficient, and there were no significant phenotypic associanton between maturation rate and the permanence of cow in the herd..

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