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GENETIC ASPECTS OF GROWTH IN GOBRA ZEBU CATTLE

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ABSTRACT

Estimates of heritabilities and phenotypic and genetic correlations between birth weight, weaning weight, weight at 12 and 18 months, and growth rate were obtained. Data from 1401 pure Gobra Zebu animals by 39 sires were evaluated at the Dahra Research Station, Senegal, West Africa, during the years 1968 through 1980. Heritabilities of all traits were moderate, 0.14 to 0.34. Phenotypic correlations were positive, the highest being 0.76 for 12 and 18 month weight; correlations with growth rate were low, 0.05 to 0.09. Genetic correlations between weights were positive, the highest being 0.94 (12 and 18 month weights); estimates for growth rate and weights, with standard errors of 0.51 to 0.57, were variable, 0.45 to -0.76. Estimates overall agreed closely with the preponderance of research on *Bos taurus* cattle in temperate beef cattle areas.

INTRODUCTION

Extensive research exists on genetic aspects of growth of *Bos taurus* beef cattle of the major pure breeds in temperate areas. Recently, comprehensive studies from tropical and subtropical areas, involving Zebu and Zebu crossbred animals, also have become available. However, there is a paucity of information on the Gobra breed (also known as the Senegal Fulani or Senegal Zebu). This is the Senegalese type of white lyre-horned Zebu spread across the Sahel by the Fulani people and known as the Sudanese Fulani in Mali and White Fulani in Niger and Nigeria. It is a triple purpose animal, but not an outstanding milk producer. The ancestors of Gobra cattle probably

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arrived in Senegal in the latter part of the 8th century (Payne, 1970). As a potentially important source of meat, additional knowledge of its growth characteristics is needed. Objectives of the present work were to characterize growth of the Gobra breed from birth to 18 months and to estimate appropriate phenotypic and genetic growth parameters.

MATERIALS AND METHODS

Data were obtained for the period 1968 through 1980 at the Dahra Research Station in Senegal and involved 1,401 purebred Gobra Zebu cattle sired by 39 bulls. Selection of animals for growth and meat production began in 1955. Subsequently, the Research Station selected bulls which were released to and used by traditional herds of the sylvo-pastoral zone of Senegal. Animals were on range throughout the year. There was little or no supplemental feeding. Other management practices included water *ad libitum,* regularly scheduled vaccinations, limited breeding seasons, partitioning of the herd into groups of animals, rational use of available pasture, and systematic weaning and culling.

All calves were weaned at 6 months. All then were grouped on the same pasture(s) from 6 to 12 months of age. They were raised separately as steers and heifers from 12 months. Seventy percent of males were culled at weaning; the remaining 30% were included in a collective 6 months testing program and selected for growth and conformation. Ten percent of the yearlings were selected to be tested individually for growth, feed consumption, sex drive, fertility and progeny performance. Each individual test lasted 12 months after which the final selection was made for bulls to be assigned to an elite cow herd. The remaining 20% of the yearlings were distributed to herders or producers using traditional systems.

Eighty percent of females were maintained as replacement heifers at weaning. They were bred at 23 to 24 months of age by the young bulls in the individual testing program. After three parturitions they were culled, sent to traditional herders or selected as elite cows based on their performance records. Growth performance was characterized through analyses of birth weight, weaning weight, 12 month weight, and 18 month weight.

Analyses of variance of data were made by the method of least squares analysis of variance, using the Mixed Model Least Squares and Maximum Likelihood computer program of Harvey (1977). Estimates of heritability and phenotypic and genetic correlations were from paternal half-sib variances and covariances. The mathematical model assumed for analysis was:

$$Y_{ijk} = u + A_i + F_k + E_{ijk}$$

Where: Y_{ijk} = an individual observation
u = the overall mean, a fixed effect common to all observations,
A_i = random effect due to ith sire,
F_k = a set of fixed effects due to sex, year of birth, month of birth, age of dam, and
E_{ijk} = random error, with the usual assumptions.

Data then were analyzed separately for each sex. Growth rates were determined from a similar model in which data were transformed to natural logs and animal and age of animal were substituted in the model for sire. The rate constant which resulted was assumed to represent growth rate; these were analyzed to estimate genetic parameters. Only female data could be used for analyses of growth rate.

RESULTS AND DISCUSSION

Means for males and females, and overall means, are in Table I. Changes in weight were acceptable for the location and time period involved.

Table I - Least squares means and standard errors for weights at various ages, by sex (in kg).

Category	Birth weight	Weaning weight	12 Month weight	18 Month weight
Female	24.9 ± 4.3	104.4 ± 23.8	141.4 ± 33.0	198.5 ± 41.0
Male	26.4 ± 5.1	114.0 ± 30.3	152.7 ± 35.0	226.8 ± 52.9
Overall	25.5 ± 4.6	107.8 ± 26.5	145.0 ± 34.3	207.6 ± 26.6

Birth weight

Heritability estimates obtained from paternal half-sib correlations, and genetic and phenotypic correlations, are in Table II. Heritability estimates were 0.14 ± 0.09 for all calves and 0.20 ± 0.14 for females. Similar results were reported for *Bos indicus* cattle by Plasse *et al.* (1968), Beltran (1976), and Nodot (1980). Oliveira *et al.* (1982a, 1982b) obtained pooled within sex estimates of 0.28 and 0.31 for Canchin calves in Brazil. Genetic and phenotypic correlations of birth weight with weaning, 12 month and 18 month weights all were positive. In females, genetic correlations between birth weight and weaning, 12 month and 18 month weights were 0.45, 0.23 and 0.37, respectively. In all calves, they were 0.49, 0.31 and 0.14. These values are lower than those reported by Cartwright and Fitzhugh (1972) in Brahman cattle but agree with those of Koger *et al.* (1957) and Beltran (1976). Oliveira *et al.*

(1982b) estimated genetic correlations between birth weight and weight at 6 and 12 months to be 0.14, and 0.08. Phenotypic correlations between birth weight and weaning, 12 month and 18 month weights were estimated at 0.30, 0.26 and 0.22, respectively, in all calves and 0.29, 0.22 and 0.23 in females.

Table II - Heritabilities and phenotypic and genetic correlations between body weights (all data)[1].

Traits	1	2	3	4	5
1. Birth weight	0.14[2] (0.09)	0.30	0.26	0.22	0.07
2. Weaning weight	0.49 (0.31)	0.34 (0.13)	0.73	0.64	0.06
3. 12 Month weight	0.31 (0.34)	0.73 (0.14)	0.33 (0.13)	0.76	0.09
4. 18 Month weight	0.14 (0.45)	0.75 (0.18)	0.94 (0.09)	0.15 (0.09)	0.05
5. Growth rate[3]	0.45 (0.51)	- 0.21 (0.52)	0.01 (0.57)	- 0.76 (0.51)	- 0.22 (0.18)

[1] Estimates are pooled within sex.

[2] Heritabilities are located on the diagonal, phenotypic correlations above the diagonal, genetic correlations below the diagonal.

[3] Estimates for growth rate based on female data only.

Weaning weight

In female calves, genetic correlations between weaning weight and 12 month and 18 month weights were 0.67 and 0.52, whereas phenotypic correlations were 0.71 and 0.59. In all calves, corresponding correlations were 0.73 and 0.75, and 0.73 and 0.64. These genetic correlations fell in the range of 0.50 to over 0.60 reported by Cartwright and Fitzhugh (1972) for weights taken at different ages on Brahman cattle. Mariante (1978), working with Nellore cattle in Brazil, however, found higher values than those found in this study. He reported genetic correlations of 0.86 and 0.62 and phenotypic correlations of 0.83 and 0.70, between weaning weight and 12 and 18 month weights.

Twelve and 18 month weights

Heritability estimates for 12 month and 18 month weights were 0.41 ± 0.18 and 0.23 ± 0.15 in female calves and 0.33 ± 0.13 and 0.15 ± 0.90 in all calves. Pacho (1981) found estimates of 0.13 ± 0.10 and 0.22 ± 0.18 for weights at 12 and 18 months in Brahman heifers. Similar low values were reported for Brahman and Nellore calves by Beltran (1976) and Mariante (1978). Pacho (1981) suggested that low estimates were due to environmental stress resulting in increased environmental variance. Woldehawariat *et al.* (1979), however, reported a heritability of 0.44 for pasture yearling weight in beef cattle.

Estimates of genetic and phenotypic correlations between 12 month and 18 month weights in heifers were 0.92 ± 0.19 and 0.70. In all calves, estimates were 0.94 ± 0.09 and 0.76. These were the highest that were obtained between any two growth traits in our study. This is in accordance with the fact that body weights taken at closer ages are more highly correlated than those taken at more distant ages. There also is evidence that correlations between two body weights taken under the maternal environment tended to be lower than those obtained between postweaning body weights (e.g., in heifers, correlations were 0.45 and 0.49 between birth weight and weaning weight, and 0.67 and 0.71 between weaning weight and 12 month weight). Heritabilities of weight gains were found to be 0.38, 0.27, 0.09, and 0.09, for the periods birth to 6 months, 6 to 12 months, 12 to 18 months, and 18 to 24 months, by Oliveira *et al.* (1983).

Growth rates

These estimates involved a smaller data set, since they were based only on 244 females with repeated measurements. Heritability estimate for growth rate was 0.22 ± 0.18 (Table II). Genetic correlations between growth rate and body weight at birth, weaning, 12 and 18 months were 0.45 ± 0.51, -0.21 ± 0.52, 0.01 ± 0.57 and -0.76 ± 0.51. The phenotypic correlation between mature weight and rate of maturity was negative (-0.06). This series of low to negative correlations agreed with findings of earlier authors (Joandet, 1967; Brown *et al.*, 1972). Their direction and magnitude confirmed observations of Joandet (1967), Fitzhugh *et al.* (1971) and Wong (1974) that rapidly maturing beef females did go to a lighter mature weight and vice versa. However, early maturing females may not be lighter at birth than later maturing ones as suggested by Brown *et al.* (1972).

Overall, heritability estimates indicated that progress can be made through selection for growth. Selection for weaning weight in females would be expected to be about 0.89 and 0.50 as efficient in improving 12 month and 18 month weights, as selection for the traits themselves directly. Genetic correlations between body weights, although indicating that correlated responses in selecting for growth should be anticipated, suggest that selection for relative growth rate in females could be expected to decrease both weaning and 18 month weight. Results for Gobra cattle were consistent with reports on other breeds in other environments.

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RESUMO

Foram obtidas as estimativas de herdabilidades e correlações fenotípicas e genéticas entre peso ao nascer, peso ao desmame, peso a 12 e 18 meses e taxa de crescimento. Dados de 1401 animais Gobra Zebu puros de 39 machos reprodutores foram avaliados na Estação de Pesquisa Dahra, Senegal, Oeste da África, durante os anos de 1968 até 1980. As herdabilidades de todas as características foram moderadas, 0.14 a 0.34. As correlações fenotípicas foram positivas, sendo a mais alta 0,76 para o peso a 12 e 18 meses: as correlações com a taxa de crescimento foram baixas, 0,05 e 0,09. As correlações genéticas entre pesos foram positivas, sendo a mais alta 0,94 (peso a 12 e 18 meses); as estimativas para taxa de crescimento e pesos, com erros padrão de 0,51 a 0,57, foram variáveis, 0,45 a -0,76. As estimativas globais concordaram com a maior parte das pesquisas sobre gado *Bos taurus* em áreas de gado de corte de clima temperado.

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