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HERITABILITY OF WEANING WEIGHT IN 'NARIMASTER' BEEF CALVES

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ABSTRACT

Data from pure and crossbred animals of Bhagnari (BN) and Australian Droughtmaster (DM) were analyzed to estimate genetic part of variance in weaning weight of 'Narimaster' (62.5% DM : 37.5% BN) animals. Weaning weight averaged 129.7 kg in 74 calves having sire identification. The sire effects were non-significant statistically while sex of the calf had a significant effect ($P<.05$) on the trait. Heritability (h^2) estimate by an animal model was 0.08. Best Linear Unbiased Estimates (BLUE) of weaning weight for male and female calves were 133.9 and 125.5 kg, respectively. Additive genetic variance was 17.64 kg^2 while error variance was 214.0 kg^2. Both phenotypic and genetic trends were positive but not different from zero, statistically. The study was limited by the availability of data, however, it was justified since it included the whole population of 'Narimaster'.

INTRODUCTION

The plan to develop a beef breed for Pakistan was started in 1969 after receiving a gift of five Droughtmaster cows and one bull from Australia. These animals were kept at Beef Production Research Center Sibi, in Balochistan province, for crossing with the native Bhagnari cattle. The cross breeding between Droughtmaster and Bhagnari animals was initiated in 1970. The plan of breed development was to cross Droughtmaster males with Bhagnari females and then cross C_1 females (having 50% Bhagnari and 50% Droughtmaster inheritance) to the Bhagnari males to get C_2 (having 25% Droughtmaster and 75% Bhagnari inheritance). The females from C_2 were to be crossed with Droughtmaster males to get C_3 (having 62.5% Droughtmaster and 37.5% Bhagnari inheritance). These C_3 animals were to be crossed *inter se*, followed by the selection process for fixation of characters (Babar, 1977). These C_3 animals having 62.5% inheritance of Droughtmaster and 37.5% inheritance of Bhagnari have been named as 'Narimaster', although it is a very small group of animals requiring breed characterization..

Data generated at the Beef Production Research Center, Sibi, are utilized in this study to draw inferences with respect to weaning weight performance of 'Narimaster' cattle.

MATERIALS AND METHODS

Weaning weight and pedigree records of 'Narimaster' beef calves from Beef Research Center Sibi, Balochistan from 1970 to 1994 were used. The model used was as follows:

$Y = X\beta + Zu + e$. Based on this model, the BLUP equations (Henderson's mixed model equations) can be written as follows:

$$\begin{bmatrix} X'R^{-1}X & X'R^{-1}Z \\ Z'R^{-1}X & Z'R^{-1}Z+\lambda A^{-1} \end{bmatrix} = \begin{bmatrix} \hat{\beta} \\ \hat{u} \end{bmatrix} \begin{bmatrix} X'R^{-1}Y \\ Z'R^{-1}Y \end{bmatrix}$$

Where Y is vector of observations, X is a known incidence matrix (74 x 2) relating sex of calf (the fixed effect) to the observation matrix (weaning weight), $\hat{\beta}$ is vector of unknown fixed effect solutions, Z is the known incidence matrix relating animals (all animals including the animals having birth weight recorded on them and other related animals) to the weaning weight data, $\hat{u}$ is vector of animal solutions i.e. breeding values. The numerator relationship matrix (A^{-1}) was included to account for all known relationships and variance components for λ (σ_e^2/σ_a^2) employed for this purpose were based on the results from paternal half-sib analysis. Heritability was calculated as the ratio of animal variance to total variance (animal + residual variance). The expectations and variances can be computed as follows (Henderson, 1988):

$E(\beta) = E(u) = E(e) = 0$; $E(y) = X\beta$

$$V \begin{bmatrix} u \\ e \end{bmatrix} = \begin{bmatrix} G & 0 \\ 0 & R \end{bmatrix}$$

where G and R are known, positive definite matrices. Consequently, V(y) = ZGZ' + R, and Cov(y,u) = ZG and Cov(y,e) = R. Pedigrees were traced back to the base population of imported Droughtmaster and native Bhagnari animals initially used for crossbreeding. The mixed model equations were solved by JSPFS (Misztal, 1992).

RESULTS AND DISCUSSION

A total of 101 'Narimaster' calves were reported to have been weighed at birth from 1983 to 1994. Out of these animals only 74 calves had information on weaning weight. Weaning weight averaged 129.7 kg in these calves. This was higher than the overall average of 111.4 kg for any type of calf weaned at the farm. Analysis of Narimaster weaning weight data (Table 1) revealed that weaning weight was lowly heritable (h^2 = 0.08). The Best Linear Unbiased Estimates for the sex effects were 133.85 kg for males and 125.48 kg for females. Other fixed effects such as season of birth were included in the preliminary analyses but were removed as matrices would not be positive definite.

Average breeding values along with the phenotypic averages for different years of birth are presented in Table 2. Both phenotypic and genetic trends were positive across the years but genetic trend was not very prominent. Conclusions are however, limited due to very few observations.

Table 1: Results of animal model analysis of weaning weight (kg) data in 'Narimaster' calves.

Item	Number/Estimate
Number of records	74
Total number of equations	188
BLUE* for Males (kg)	133.85
BLUE for Females (kg)	125.48
Additive animal variance (kg^2)	17.64
Error variance (kg^2)	213.98
Heritability estimate	0.08

*Best Linear Unbiased Estimate

Very low heritability of weaning weight (8%) in the Narimaster population is similar to other studies on beef cattle populations (Cantet *et al.*, 1988; Johnston *et al.*, 1992;). Cantet *et al.* (1988) reported the weaning weight in Hereford cattle to be 6% heritable. Johnston *et al.* (1992) reported that weaning weight in Canadian Charolais (n=1419) was 9% heritable. Higher estimates for weaning weight in beef cattle have also been reported. Estimate of heritability was 36% in the study of Moreira and Cardellino (1994) on 9,177 Hereford calves. In another study on Zebu crossbreds (Mackinnon *et al.*, 1991), weaning weight was reported to be as high as 56% heritable. The average estimate from 53 studies reviewed by Mohiuddin (1993), however, was 22%. The weighed estimate (by inverse of sampling variance) from 234 studies as reported by Koots *et al.* (1994) was 24%.

Low genetic contribution to the overall variation in weaning weight indicated that direct selection for this trait may not be fruitful. Yet, indirect selection by selecting for higher birth weight would cause genetic improvement in this trait because of the high genetic correlation between the two traits (Khan, 1996) . This option may be practicable with a caution that selection for higher birth weight is usually associated with calving difficulty and thus improvement in weaning weight by selecting for birth weight may not be suggestive on a long term basis. For few generations in the future, adapting this option might not cause any harmful effect in terms of calf or cow losses as the current average birth weight in the population was 24 kg.

Table 2. Least Squares Means values (± SE) for phenotype and breeding values of weaning weight (Kg) in 'Narimaster' population across different years.

Year of Birth	Obs	Phenotype	Breeding values
≤ 1984	2	112.0 ± 13.34	127.4 ± 1.32
1985	2	139.5 ± 9.43	128.1 ± 0.93
1986	3	130.3 ± 7.70	129.1 ± 0.76
1987	3	114.7 ± 7.70	127.6 ± 0.76
1988	2	108.5 ± 9.43	127.1 ± 0.93
1989	4	129.7 ± 6.67	129.8 ± 0.66
1990	11	146.3 ± 4.02	131.4 ± 0.40
1991	10	126.6 ± 4.21	130.5 ± 0.42
1992	9	133.4 ± 4.44	129.8 ± 0.44
1993	21	123.5 ± 2.91	129.5 ± 0.29
1994	7	136.0 ± 5.04	129.2 ± 0.50

CONCLUSIONS

Low heritability estimate of weaning weight in 'Narimaster' calves in the present study indicates that faster improvement by mass selection can not be achieved in the trait. More precise data recording for better accounting of environmental variance and better data sets might be helpful in drawing conclusions.

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