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Genetic and Phenotypic (Co) variance for Yearling Weight and Post-weaning Growth Rate in Bhagnari × Droughtmaster Calves

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Abstract
Heritabilities of and correlations between yearling weight and post-weaning growth rate in Bhagnari and its crosses with Australian Droughtmaster cattle in Balochistan were estimated. Out of 1118 weaning weight observations with sire identification, only 136 had yearling weight recorded on them. The overall mean for the yearling weight was 151.5 ± 38.9 kg while post-weaning growth rate averaged 261 ± 56 gm. Heritability of the traits estimated by paternal half-sib correlation was 0.19 ± 0.24 and 0.03 ± 0.20, respectively. Very large standard errors reflected the scarcity of data points. Both the traits were highly positively correlated (0.72) due to the fact that the growth rate was derived from the yearling weight. The environmental correlation had a similar magnitude (0.67) but genetic correlation was unrealistic.

Key words: Bhagnari, correlation, yearling weight, post-weaning growth

Introduction
Crossbreeding project to develop a beef breed for Pakistan continues at Beef Production Research Centre Sibi, Balochistan since 1969. The plan started when a gift of five Droughtmaster cows and one bull were received from Australia. Crossbreeding experiments were initiated in 1970. Initially, Sahiwal, Tharparkar and Bhagnari breeds were used for crossbreeding but Sahiwal and Tharparkar were dropped and subsequent work of crossing Droughtmaster continued with Bhagnari.

The Bhagnari cattle, apart from their good draft qualities, are considered potential beef producer. Most of the animals of this breed are found in the plains of Sibi, Kachhi and Nasirabad Districts of Balochistan. The males weighund 600 kg while females weigh about 480 kg (Khan *et al.,* 1984). The Droughtmaster on the other hand, is a crossbred cattle of Australian origin having 40-60 percent Bos indicus inheritance. Qualities such as fertility, growth rate, docility and tick resistance are some of the important features of the breed (Payne, 1970).

The exact plan of breed development was to cross Droughtmaster males with Bhagnari females and then cross F. females (having 50% Bhagnari and 50% Droughtmaster inheritance) to the Bhagnari males to get F_2 (having 25% Droughtmaster and 75% Bhagnari inheritance). The females from F_2 were to be crossed with Droughtmaster males to get F_3 (having 62.5% Droughtmaster and 37.5% Bhagnari inheritance). These F3 animals were to be crossed inter se followed by the selection process for fixation of characters (Babar, 1977). The animals having 62.5 percent inheritance of Droughtmaster and 37.5 percent inheritance of Bhagnari have been named as 'Narimaster'.

Data accumulated at the Beef Production Research Centre, Sibi, for the last 24 years is being analyzed for drawing inferences with respect to the relative performance of these crossbred animals. The present study in a series of studies pertains to the estimation of genetic and phenotypic (co)variance components for yearling weight and post-weaning growth rate in Bhagnari and its crosses with Droughtmaster.

Materials and Methods
Weaning and yearling weight (weaning at 210 days of age) records of Bhagnari and Droughtmaster crossbreds from Beef Research Centre Sibi, Balochistan from 1970 to 1993 were used for the present study. Animals were required to have at least sire identification. Post-weaning growth rate was calculated by subtracting the weaning weight from yearling weight and dividing the remainder by 155 (i.e. 365 -210). After editing for unrealistic entries, the phenotypic and genetic variances of the two traits and covariances between them were calculated for estimation of heritability and phenotypic and genetic correlations between them using paternal half-sib correlation, technique. The mixed model used to calculate sire variance and covariance included random sire effect and fixed effects of year and season of birth, sex of the calf and percentage of Droughtmaster inheritance (as covariable).

Four seasons of birth were defined as spring (February to April), summer (May to July), autumn (August to October) and winter (November to January). The data manipulation was done by SAS (1990) and genetic parameter estimation was done by LSMLMW (Harvey, 1990).

Results and Discussion
Out of 1118 weaning weight observations with sire identification known, only 136 had yearling weight recorded on them. To calculate covariance between post-weaning growth rate and yearling weight, study was thus restricted to calves having both weaning and yearling weight recorded on them.

Yearling weight: The yearling weight is a very important economic trait for commercial beef production, especially

Table 1: Analyses of variance for estimation of genetic parameters of yearling weight (kg) and post-weaning growth rate (gm)

Source of variation	df	Yearling weight		Post-weaning growth rate	
		Mean Squares	F-ratio	Mean Squares	F-ratio
Sire	6	1762.1	1.45^{NS}	19018.1	1.07^{Ns}
Year of birth	5	3898.2	3.20**	148034.8	8.34**
Season of birth	3	192.7	0.16^{NS}	53724.0	3.03*
Sex	1	8822.3	7.24**	39276.8	2.21^{Ns}
Droughtmaster %	1	13295.8	10.91**	118135.0	6.66*
Remainder	119	1218.9		17744.2	

Table 2: (Co)variance components* of yearling weight (kg) and post-weaning growth rate (gm)

Trait	Parameter	Estimate
Yearling weight	Sire variance (σ_s^2 YWT)	63.08
	Error variance (σ_s^2 $_{YWT}$)	1218.87
	Heritability	0.19±0.24
Post-weaning growth rate	Sire variance (σ_s^2 PWGR)	147.93
	Error variance (σ_e^2 PWGR)	17744.18
	Heritability	0.03±0.20
	Sire $Cov_{(YWT\ PWGR)}$	154.46
	Error $Cov_{(YWT\ PWGR)}$	3312.38
	Phenotypic correlation	0.72
	Environmental correlation	0.67
	Genetic correlation	1.59

*Heritability = $4 \times ((\sigma_s^2)/(\sigma_s^2+\sigma_e^2))$ *Genetic correlation = (Sire $CO_{(YWT\ PWGM)}$) = $\sqrt{(\sigma_s^2 \text{YWT})(\sigma_s^2 \text{PWGR})}$

on rangelands. The overall mean for the yearling weight obtained from this study was 151.5±38.9 kg. Results obtained from the analyses of variance are given in (Table 1) Similar to that of weaning weight, sire was found unimportant to explain the phenotypic variation in the trait. Seasonal effects which were very pronounced at birth weight (Khan, 1996) had been diluted and it did not matter in which of the four seasons calf was born. Year of birth still was an important variation source along with the sex of the calf. But as evident from the F-values (Table 1), higher the percentage of Droughtmaster inheritance, heavier the calf, similar to the results for pre-weaning traits (Khan and Khan, 1999). Number of observations for this trait were only 136, the number of sire represented in the data were only seven and data were spread over six years in the start of the project (1971-1976).

Heritability estimate from paternal half-sib correlation were 0.19±0.24 (Table 2). Very high standard error reflects the scarcity of data points. These estimates imply that yearling weight was a lowly heritable trait and environment controlled most of the variation. These estimates were similar to those (0.14±0.02) reported by Massey and Benyshek (1981) in Limousin breed. Morris *et al.* (1992) reported 0.17±0.06 as an estimate for yearling weight heritability in Hereford cattle. Koots *et al.* (1994) reported an average of 0.33 from 154 studies in the literature. Estimates ranged from 0.43 to 0.45 for Hereford and American Angus in the study of Fan *et al.* (1995). Estimate of heritability in present study have a limited application due to very high standard error. Yearling weight records after 1976 were not available and thus data for analysis were very scarce.

Post-weaning growth rate: Average post-weaning growth rate from 136 observations on the trait was 261 gm with a high standard deviation of 156 gm. Analysis of variance for post-weaning growth rate is presented in Table 1. Heritability estimate from paternal half-sib correlation were close to zero (0.03±0.20). A large standard error again reflected the scarcity of data points. Phenotypic, genetic, and environmental correlation with yearling weight are presented in Table 2. Heritability estimates on post-weaning growth rate have been less frequently reported as compared to other growth traits. Wilson *et al.* (1986) reported low estimates (0.16 and 0.15) for American Hereford and American Angus breeds. In Brahman cattle an estimate of similar magnitude (0.17) was reported by Berruecos *et al.* (1976).

Yearling weight and post-weaning growth rate were highly positively correlated (0.72) due to the fact that the growth rate was derived from the yearling weight. Environmental correlation had a similar magnitude (0.67) but genetic correlation was unrealistic (1.59). Such unrealistic parameters are possibilities from analyses with very few number of observations and from methods such as employed in this study. A solution to this is REML type estimation where estimates are- forced to be in the parameter space, requiring variance-covariance estimator matrix to be positive definite bit due to very small number of observations such analyses were not tempted.

In most of the studies found in literature the two traits were reported to be highly correlated. Francoise *er al.* (1973) reported the estimate 0.66 in Angus and Hereford cattle. Mavrogenis *et al.* (1978) reported it to be 0.71 for Hereford cattle. Dinkel and Busch (1973) reported genetic correlation between yearling weight and post-weaning growth rate to be 0.99 in Hereford cattle. Estimate presented by Veseth *et al.* (1993) for Hereford cattle was unrealistic (1.04) similar to the estimate obtained in the present study.

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