GENETIC AND PHENOTYPIC EVALUATION OF THE GROWTH PERFORMANCE OF BHAGNARI AND DROUGHTMASTER X BHAGNARI FEMALE CALVES IN PAKISTAN

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ABSTRACT

Pedigree and performance records of 296 Bhagnari and Droughtmaster x Bhagnari crossbred cows maintained at the Beef Production Research Centre, Sibi (Balochistan) accumulated over a period of 30 years from 1969 to 1999, were utilized for the present study. The least squares means for birth weight, weaning weight and pre-weaning average daily gain were 23.49 ± 3.76, 107.46 ± 19.00 and 390.00 ± 97 g having coefficients of variation of 12.89, 13.75 and 13.75%, respectively. Year of birth significantly influenced birth weight, weaning weight and pre-weaning average daily gain, while season of birth appeared to be a non-significant source of variation for all of the performance traits studied. Genetic group of the cows had a significant effect on birth weight, while other traits including weaning weight and pre-weaning average daily gain, were non-significantly affected by the genetic group of the cow. Genetic group of the dam had a non-significant influence on body weights at birth and weaning ($P>0.05$). The heritability estimates of birth weight, weaning weight and pre-weaning average daily gain were found to be 0.09 ± 0.02, 0.09 ± 0.01, and 0.01 ± 0.01, respectively. The estimates of phenotypic and genetic correlation between birth weight and weaning weight were -0.23 and -0.74, respectively. The estimated breeding values ranged from –171.44 to 242.48 kg for birth weight and from –171.44 to 22.48 kg for weaning weight. Estimated breeding values obtained were used to compute the genetic trends for various performance traits. The genetic trends for birth weight was negative and for weaning weight it was slightly positive. All phenotypic trends were negative with the exception of the one for weaning weight, which was slightly positive.

Key words: Genetic and phenotypic evaluation, Bhagnari, Droughtmaster × Bhagnari

INTRODUCTION

Pakistan possesses 46.8 million heads of cattle and buffaloes which supply 1010 thousand tonnes of beef per annum (Anonymous, 2002). Actually beef is obtained as a by product of dairy industry and draught power in Pakistan. Male buffalo and cow calves are the major source of beef in the country as they are extensively slaughtered. In Pakistan, the problem of animal protein deficiency is very acute, especially in the low income groups. Per capita availability of beef in Pakistan is only 15.84 Kg, which is very low as compared to the developed countries of the world. Per capita availability of beef is also far below the standards of World Health Organization (Anonymous, 1994). This insufficiency is due to the sub-optimal productivity of our indigenous cattle as a result of uncontrolled breeding, inadequate feeding, management and disease control measures. Most of the cattle population in the country is non-descript and has poor genetic potential for beef production.

Bhagnari cattle were selected to be the *Bos indicus* parent in the breeding programme because these animals appeared to have good potential for beef production, having relatively higher birth weights, faster subsequent growth rate, good feed efficiency and fair milk production. It has been reported that a male of this breed can attain the maximum weight of about 818 kg in the prime age of 6 to 8 years while under exceptional management conditions it can attain as much as 1136 kg of live weight in a period of 8 to 10 years (Babar, 1977). The specimens of this breed are present in the plains of Sibi, Kacchi and Nasirabad districts of Balochistan.

The Droughtmaster is a crossbred animal originated in Australia with 3/8 to 5/8 *Bos indicus* inheritance. *Bos indicus* inheritance is mainly derived from Red American Brahman and Africander. There is also some infusion of Santa Gertrudis blood. The temperate type *Bos taurus* inheritances has been derived from Devon, Shorthorn, Hereford and Red Poll breeds, together with some genes from the Shorthorn through Santa Gertrudis. These cattle are large, long bodied and well fleshed. The coat colour is light or dark red. There are both horned and polled individuals. Good fertility, growth rate, docility and tick resistance are some of the desirable features of this breed (Hill, 1990).

Data on various performance traits of Bhagnari and Droughtmaster x Bhagnari animals have accumulated at the Beef Production Research Centre, Sibi over the last

30 years. Analyses of this data could help in the evaluation of the performance of these animals. It could also provide useful information for the formulation of future breeding plans for the improvement of these animals and their propagation in the country. It was thus planned to thrash out various aspects of production, reproduction and adaptability through a series of studies. Bashir (1996) has analyzed the growth traits of calves for the evaluation of different non-genetic factors while the study conducted by Khan (1996) focussed on the estimation of genetic parameters for these growth traits. The studies involving evaluation of the performance of cows of this herd were lacking. The present study was thus planned with the following objectives:

- To evaluate the performance of Bhagnari and Droughtmaster x Bhagnari crossbred cows in Pakistan.
- To evaluate the influence of various non-genetic factors on the performance traits
- To estimate genetic and phenotypic parameters for different performance traits
- To estimate breeding values of animals.

MATERIALS AND METHODS

Pedigree and performance records of Bhagnari and Droughtmaster x Bhagnari crossbred cows of varying grades maintained at the Beef Production Research Centre, Sibi during 1969-1999 were utilized for the present study. Beef Production Research Centre, Sibi was established in 1969 at Sibi. About 500 acres of land was allotted by the Government for the establishment of this Centre. A beef cattle crossbreeding project involving Bhagnari and Australian Droughtmaster was planned to be undertaken at this Centre. The main objective of this exercise was to develop a synthetic strain of beef cattle having 37.5% Bhagnari and 62.5% Droughtmaster inheritance. The rapid planned synthetic was expected to have early maturity, higher growth rate and better feed efficiency coupled with disease resistance and adaptability to the local environmental conditions.

Following data were collected: Individual's identity, sire, dam, date of birth, dates of service, conception and calving, date of disposal, birth and weaning weights of the calves weaned by a cow and body weight of cows at various ages. In addition to the basic edits of consistency checks for dates and animal identities, records of cows which had aborted, missed a year due to sickness or other reasons were eliminated. The performance records outside ± 3 phenotypic standard deviations from the mean were excluded. The traits examined included birth weight, weaning weight and average weaning average daily gain of female calves. Characteristics of the data structure for various performance traits used in the analysis are given in Table 1.

Evaluation of environmental factors

Data on various performance traits were analyzed to evaluate the influence of different environmental factors (e.g. year and season of birth/calving, age at first calving and calving interval) on these traits. The year of birth or calving was divided into the four seasons viz. spring (February to April), summer (May to July), autumn (August to October) and winter (November to January). The performance records collected were of Bhagnari, Droughtmaster and their crosses. As the records were from a population having different genetic groups, the effect of genotype was also included in the model. Different genetic groups represented in the data with percentage of Droughtmaster inheritance are given in Table 2.

The mathematical model assumed was:

$$Y_{ij} = \mu + F_i + e_{ij} \quad \text{(Model 1)}$$

Where,

Y_{ij} = measurement of a particular trait

μ = population mean

F_i = the effect of all fixed effects

E_{ij} = the random error associated with each observation.

Harvey's Mixed Model Least Squares and Maximum Likelihood Computer Program (Harvey, 1990) was used in all these analyses.

Estimation of genetic parameters

The genetic parameters namely heritability of different performance traits and the genetic correlations between all plausible combinations were estimated using restricted maximum likelihood procedure (Patterson and Thompson, 1971) fitting an individual animal model. For this purpose derivative free restricted maximum likelihood (DFREML) set of computer programmes (Meyer, 1997) was used. All of the available pedigree information was

Table 1: Characteristics of the data structure for various performance traits

Traits	No. of records	No. of animals	No. of sires with progeny	No. of dams with progeny	Mean	Years
Birth weight of cow	208	256	15	31	23.49 (3.76)*	1972-95
Weaning weight (9th month of age)	208	256	15	31	107.46 (19.00)	1972-95
Average daily gain	335**	392	19	34	0.390 (0.097)	1970-95

*Figures in the parenthesis are standard deviation, **Records on purchased and imported animals included.

Table 2: Genetic groups with percentage of Droughtmaster inheritance

S. No.	Breed group	Droughtmaster %
1	Bhagnari (BN)	0
2	Droughtmaster (DM)	100
3	DM x BN (F_1)	50
4	F_1 x BN	25
5	Narimaster	62.5
6	Sahiwal (SL)	0
7	SL x Friesian (SLFR)	0

included in the analysis in an attempt to minimize the bias due to selection and non-random mating. The convergence criterion (variance of function values -2 log likelihood) for various genetic parameters was 1×10^{-8}.

Heritability estimation

Heritability estimates were computed for the aforementioned traits. The mathematical model assumed for this purpose was as follows:

$$Y_{ijk} = \mu + A_i + F_j + e_{ijk} \qquad \text{(Model 2)}$$

Where.

Y_{ijk} = measurement of a particular trait;

μ = population mean;

A_i = random additive genetic effect of ith animal

F_j = fixed effects

e_{ijk} = random error with mean zero and variance σ^2_E

Phenotypic = Additive genetic + Residual

variance (σ^2_P) variance(σ^2_A) Variance (σ^2_E)

The heritability was calculated by the following formula:

Heritability (h^2) = σ^2_A / σ^2_P

Genetic and phenotypic correlations

The performance traits were analysed statistically for the estimation of genetic and phenotypic correlations between various performance traits. For this purpose bivariate analysis was carried out using Individual Animal Model REML (Patterson and Thompson, 1971). The fixed effects for various performance traits in this analysis were the same as considered in the univariate analysis (Model 2).

The bivariate analysis was carried out for the genetic and phenotypic correlations between birth weight and weaning weight. All these analyses were performed using Derivative Free Restricted Maximum Likelihood (DFREML) set of computer programmes (Meyer, 1997). The approximate standard errors of the genetic correlations were calculated after Falconer and Mackay (1997).

Estimation of breeding values and genetic trends

The DFREML set of computer programmes (Meyer, 1997) used above also generated estimates of breeding values. This programme estimates breeding values of animals by Best Linear Unbiased Prediction (BLUP) procedure as outlined by Henderson (1973). Breeding values thus estimated were fitted in a fixed effect model having year of birth as the only effect. The least squares solutions of breeding values were drawn against year of birth to depict the genetic trend. Least squares means of different performance traits were plotted against the year of birth to determine phenotypic trends.

RESULTS AND DISCUSSION

Data on various performance traits of Bhagnari and Droughtmaster X Bhagnari crossbred cows maintained at the Beef Production Research Centre, Sibi (Balochistan) collected over a period of 30 years were used in the present study. The present study involved the evaluation of environmental factors influencing various performance traits, estimation of their genetic parameters i.e. heritabilities and phenotypic, genetic and residual correlations and estimation of breeding values of animals.

PHENOTYPIC PERFORMANCE

The average birth weight of the cows of various genetic groups was 23.49 ± 3.76 kg in the herd. The weaning weight averaged 107.46 ± 19.00 kg. The Pre-weaning average daily gain was 390.00 ± 97 g. Out of these growth traits, pre-weaning average daily gain appeared to be highly variable with coefficient of variation of 22.37%. The birth weight and weaning weight of the cows had almost similar coefficients of variation i.e. around 13%.

ENVIRONMENTAL FACTORS

The influence of various environmental factors on birth weight of the cows, weaning weight of the cows and pre-weaning average daily gain of the cows was evaluated as these traits showed wide variation under varying sets of conditions.

Birth weight of the cows

The analysis of variance for the evaluation of influence of year of birth, season of birth and genetic group and age of the dam is presented in Table 3. The analysis of the data indicated that effect of year of birth and genetic group was significant (P<0.05) while season of birth and age of dam of the female calves had no effect on birth weight.

The least squares means alongwith the standard errors for birth weight of cows for different years, seasons and genetic groups have been given in Table 4. The least squares mean of birth weight of female calves was 18 kg in 1972. Low birth weight in the early years of the project at Sibi is surprising but may be due to the fact that only one observation was involved in this year. It increased to

26 kg in the next year and then again decreased to 23 kg. It fluctuated between 24 to 26 kg in the year 1976 to 1979. In the next 9 years from 1980 to 1989 it varied from 20 to 23 kg in different years.

There was an increase in birth weight in 1990 to 1991 but again it decreased and remained nearly 24 kg in the next four years. The least squares mean for birth weight of the females calves born during different seasons varied non-significantly and the birth weight was nearly the same (24 kg) in spring and summer born calves while it was around 23 kg in the calves born during autumn and winter. The birth weight of female calves of different genetic groups varied between 21 and 26 kg ($P<0.05$). Droughtmaster female calves had the highest (26 kg) birth weight and Bhagnari female calves had the lowest birth weight (20 kg). It was 25 kg in the Narimaster female calves. The significant effect of year of birth of the calves and genetic group is in agreement with the findings of many workers (Robertson and Sanders, 1983; Oliveira *et al.*, 1989; Garcia-Paloma *et al.*, 1992; Rege *et al.* 1992). Rege *et al.* (1992) analysed the data of Charolais, Short horn, Sokoto Gudali and their Jersey F_1 and back crosses. Body weight at birth was reported to be significantly influenced by the calf genotype and the year of birth. Oliveira *et al.* (1989) analysed the performance records of 157 Santa Gertrudis cows. Birth weight was reported to be significantly affected by the year of birth. The non-significant effect of season of birth and age of dam on birth weight as obtained in the present study is not in line with the results obtained elsewhere (Robertson and Sanders, 1983; Oliveira *et al.*, 1989; Rege *et al.*, 1992).

Weaning weight

The analysis of variance for the evaluation of the influence of year of birth, season of birth and the genetic group as obtained in the present study is given in Table 3. Analysis showed that only effects of year of birth was significant ($P<0.01$). The least squares means of weaning weights of female calves for different years of birth, seasons of birth and genetic groups are presented in the Table 4.

The data showed that the weaning weight of female calves of this herd was minimum in 1972 which is surprising because in the early years of the project, it was expected to be higher. It had sudden fluctuations. It increased in 1974 and then fluctuated between years with no specific trend. It remained between 108 and 127 kg during the period from 1989 onwards.

The least squares means of weaning weight of female calves born in different seasons showed a non-significant differences ($P<0.05$), and remained nearly the same (105 kg) with slight decrease in autumn (101 kg).

The least squares means of weaning weights of female calves of different genetic groups did not vary significantly. The female calves of Bhagnari breed had the minimum weaning weight of 100 kg, while that of the Narimasters was 110 kg. The significant effect of year of birth on weaning weight is in agreement with the findings of Bastidas *et al.* (1981) and Warnick *et al.* (1990). These workers, however, reported a significant effect of season of birth/month of birth on weaning weight. Contrary to the findings of the present study, Arije and Wiltbank (1974) reported a non-significant effect of year of birth on weaning weight. The data of 310 Hereford heifers was analysed and it was reported that weaning weight did not differ significantly between years ($P>0.05$).

Bastidas *et al.* (1981) analysed weaning weight data of 305 Brahman calves born in 1977 and 1978 and reported that year of birth had a significant effect on weaning weight while month of birth of the calf had a highly significant effect on weaning weight. Warnick *et al.* (1990) conducted evaluation of Hereford, Brahman-Hereford and Brown Swiss-Hereford cows for calf production and reported that weaning weights were higher ($P<0.05$) for spring born than the fall born calves.

Pre-weaning average daily gain

The analysis of variance for the evaluation of the influence of year of birth, season of birth and genetic group is given in Table 3. This analysis showed that only year of birth significantly affected this trait. The effects of season of birth and genetic group on pre-weaning average daily gain were non-significant statistically.

The least squares means and standard errors for pre-weaning average daily gain of the female calves of different genetic groups born during different years and seasons is given in Table 4. A perusal of this table indicates that the maximum pre-weaning average daily gain was observed in the year 1970 (509 g/day). Animals in the early years of the project at Sibi were expected to have higher pre-weaning average daily gain because they were free from anything like inbreeding depression. Moreover, there was expected to be more enthusiasm for the study reflected in terms of better feeding and management in those early years viz. 1970 to 1972. Pre-weaning average daily gain gradually decreased which increased in the next year and again decreased in the same fashion until 1976. In 1978, it increased but again reduced in 1981. It showed a gradual increase in the years 1981 to 1987 with minor fluctuations but in the following years it remained above 400 grams per day. The least squares means of pre-weaning average daily gain of female calves born in different seasons showed that calves born in autumn had the lowest gains while those born in summer had the highest (404 g).

The least squares means for different genetic groups showed that the value was the maximum in the purebred Droughtmaster, followed by the Narimasters. It was minimum in Bhagnaris. This is almost the same trend as was observed for birth weight and weaning weight. The significant effect of year of birth on pre-weaning average daily gain as noted in the present study is in agreement with Garcia-Paloma *et al.* (1992) and Rege *et al.* (1992). Rege *et al.* (1992) analysed the data of Charolais, Shorthorn, Sokoto Gudali, their F_1s and back crosses. The year of birth was reported to have a significant effect on pre-weaning average daily gain. The significant effect of calf genotype on pre-weaning average daily gain reported by these worker is not in line with the findings of the present study.

GENETIC PARAMETERS

Heritability estimates

The heritability estimates of various performance traits are presented in Table 5.

Birth weight of the cows

The restricted maximum likelihood animal model estimate of heritability of birth weight was 0.09 ± 0.02. Although the heritability estimate for birth weight was low, it was in agreement with those reported by Tanida *et al.* (1988), Moulineuvo (1971), Massey and Benyshek (1981) and Khan *et al.* (1999), who reported the heritability estimates ranging from zero to 0.17 in different breeds of cattle. Several other workers have, however, reported moderate to very high estimates of heritability in various breeds of cattle. The heritability estimates ranging from 0.22 to 0.67 have been reported by Swiger (1961), Vesely and Robinson (1971), Buchanan *et al.* (1982), Burfening *et al.* (1978), Nelsen and Kress (1979), Koch (1978), Smith *et al.* (1989) and Bourdon and Brinks (1982) in different breeds of cattle. The estimates of heritability in Hereford cattle had been reported to be zero using paternal half-sib correlation and 0.01 using daughter dam regression procedure which is slightly lower than the estimates of the present study. However, Vesely and Robinson (1971) reported heritability estimate of 0.67 in this breed of cattle which is very high as compared to most studies conducted elsewhere and the present study. High estimates (0.55) as compared to the present study for birth weight had also been reported by Koch (1978) in Santa Gertrudis breed.

A wide variation in the heritability estimate of the present study and as reported by other workers could be due to several factors. The heritability for particular traits varies between breed, herds and even periods of time. Inbreeding and small size of breeding herd might reduce the genetic variation, whereas different management and environmental factors in different herds and years might increase the phenotypic variation. A low heritability estimate of birth weight in this herd indicates that larger proportions of the phenotypic variation is due to environment and the progress through selection within the herd will be slow. This estimate also suggests that there is a great scope for improving birth weight through better feeding and management.

Weaning weight of the cows

The heritability estimate of weaning weight of the cows was 0.09 ± 0.01. The heritability estimates of weaning weight have also been reported to be low by several workers (Molineuvo, 1971; Massey and Benyshek, 1981; Smith *et al.*, 1989). These workers have reported the heritability estimate ranging from 0.09 to 0.14 in various breeds of cattle. Tanida *et al.* (1988) reported a low and negative estimate (-0.03) of heritability for weaning weight in Hereford cattle. However, the estimate of heritability for weaning weight were reported to be very high in Hereford cattle in studies undertaken by Vesely and Robinson (1971) and Koch (1978), who reported the heritability of the trait as 0.50 ± 0.10 and 0.48 ± 0.25, respectively. Similar estimate of heritability of weaning weight was also reported by Burfening *et al.* (1978) in Simmental cattle. The data of 17297 weaning weights were analysed by paternal half sib correlation technique and the value of heritability was reported to be 0.48.

Swiger (1961) and Nelsen and Kress (1979) reported moderate (0.25 and 0.21) estimate of heritability for weaning weight in Hereford and Angus cattle, respectively. The results of the present study indicated that the observed variation in weaning weight of the cows was due to environmental factors. Hence, greater emphasis needs to be given on the improvement of feeding and management practices for improvement in weaning weights of the cows.

Pre-weaning average daily gain

The restricted maximum likelihood animal model estimate of pre-weaning average daily gain was 0.01 ± 0.01. This estimate of heritability of pre-weaning average daily gain was very low and this finding was similar to those reported by Massey and Benyshek (1981) and MacNeil *et al.* (1984). Massey and Benyshek (1981) reported heritability estimates of pre-weaning average daily gain as 0.08 in Limousin cattle. The estimate of heritability of pre-weaning average daily gain reported by MacNeil *et al.* (1984) was 0.09. However, the estimate of heritability reported by Bourdon and Brinks (1982) was higher than the present estimate. These workers reported the heritability of pre-weaning average daily gain as 0.66 in Angus, Red Angus and Hereford cattle.

A moderate estimate of heritability (0.22) of pre-weaning average daily gain was reported by Nelsen and Kress (1979) in Angus cattle. The low estimate of heritability of pre-weaning average daily gain as obtained in the present study suggested that the trait was mostly influenced by factors other than the genetic and the daily gain in the pre-weaning period can be reasonably increased by improving the feeding and management practices for the cow-calves.

Table 3: Analysis of variance for the evaluation of environmental effects on birth weight, weaning weight and pre-weaning average daily gains

Source of variation	Birth weight		Weaning weight		Pre-weaning average daily gain	
	MS	F-ratio	MS	F-ratio	MS	F-ratio
Season of birth	14.33	1.566 NS	134.77	0.617 NS	26400.72	3.569 NS
Year of birth	26.52	2.898*	914.45	4.189*	42070.81	5.687**
Genetic group	71.42	7.805*	288.49	1.322 NS	12830.27	1.734 NS
Age of dam	16.01	1.749 NS	223.91	1.026 NS	-	-
Remainder	9.15		218.27		7397.71	

Table : 4 Least squares means (LSM) and standard errors for birth weight, weaning weight and pre-weaning average daily gain of cows for different years, seasons and genetic groups

Classification	Birth weight (kg)		Weaning weight (kg)		Pre-weaning average daily gain (g)	
	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE
Years of birth						
1972	1	17.92 ± 3.23	1	72.65 ± 15.86	18	341.80 ± 25.83
1974	1	25.91 ± 3.12	1	117.01 ± 15.23	6	427.00 ± 38.28
1975	10	22.58 ± 1.08	10	97.42 ± 5.31	13	404.58 ± 28.73
1976	9	24.43 ± 1.11	9	98.86 ± 5.42	24	356.31 ± 22.62
1977	8	25.74 ± 1.17	8	87.93 ± 5.73	17	326.53 ± 24.59
1978	6	26.33 ± 1.31	6	129.42 ± 6.41	14	375.38 ± 26.20
1979	6	24.79 ± 1.31	6	94.04 ± 6.43	13	416.06 ± 27.64
1980	6	20.85 ± 1.29	6	88.50 ± 6.33	16	339.83 ± 25.76
1981	9	23.12 ± 1.10	9	89.76 ± 5.37	12	312.05 ± 26.08
1982	15	22.84 ± 0.85	15	94.13 ± 4.15	14	304.58 ± 26.31
1983	6	21.97 ± 1.33	6	97.71 ± 6.50	19	338.63 ± 23.54
1984	17	21.27 ± 0.82	17	98.59 ± 4.03	6	370.74 ± 38.69
1985	12	19.95 ± 0.98	12	101.50 ± 4.82	18	361.49 ± 24.77
1986	18	23.38 ± 0.81	18	111.78 ± 3.99	16	398.81 ± 26.55
1987	19	22.04 ± 0.83	19	119.35 ± 4.05	22	422.19 ± 22.75
1988	11	21.93 ± 0.99	11	96.57 ± 4.87	19	423.85 ± 24.82
1989	18	24.50 ± 0.81	18	111.73 ± 3.97	13	386.86 ± 28.29
1990	10	25.59 ± 1.04	10	127.27 ± 5.11	19	413.76 ± 24.36
1991	6	26.86 ± 1.33	6	118.30 ± 6.51	11	456.07 ± 30.53
1992	10	23.72 ± 1.06	10	114.99 ± 5.20	9	426.78 ± 33.60
1993	3	23.67 ± 1.84	3	108.14 ± 9.01	10	439.77 ± 31.76
1994	3	24.62 ± 1.84	3	114.75 ± 9.02	10	438.51 ± 31.54
1995	4	23.02 ± 1.60	4	113.56 ± 7.85	4	403.02 ± 47.40
Seasons of birth						
Spring	81	23.84 ± 0.47	81	105.70 ± 2.31	124	381.83 ± 15.14
Summer	35	23.60 ± 0.63	35	105.06 ± 3.07	59	403.89 ± 17.10
Autumn	34	23.35 ± 0.63	34	101.41 ± 3.12	68	353.63 ± 16.20
Winter	58	22.61 ± 0.51	58	105.91 ± 2.49	91	391.67 ± 14.92
Genetic groups						
Bhagnari (BN)	13	20.52 ± 0.95	13	99.75 ± 4.66	67	357.61 ± 13.97
Droughtmaster (DM)	10	26.12 ± 1.05	10	106.28 ± 5.16	17	428.42 ± 22.11
BN X DM (F1)	21	23.92 ± 0.79	21	103.00 ± 3.86	56	382.40 ± 14.27
F1 X BN	95	23.12 ± 0.41	95	105.47 ± 2.02	101	392.36 ± 10.40
Narimaster	55	25.22 ± 0.62	55	110.69 ± 3.03	65	413.00 ± 14.71
SL X Friesian	14	21.20 ± 0.96	14	101.93 ± 4.69	11	384.59 ± 28.59

Table : 5 Heritability estimates for birth weight, weaning weight and pre-weaning average daily gain

Sr. No.	Trait	No. of records	Estimate ± SE
1	Birth weight of cow	208	0.09 ± 0.02
2	Weaning weight of cow	208	0.09 ± 0.01
3	Pre-weaning average daily gain	335	0.01 ± 0.01

Fig. 1: Phenotypic and genetic trends for birth weight of cows

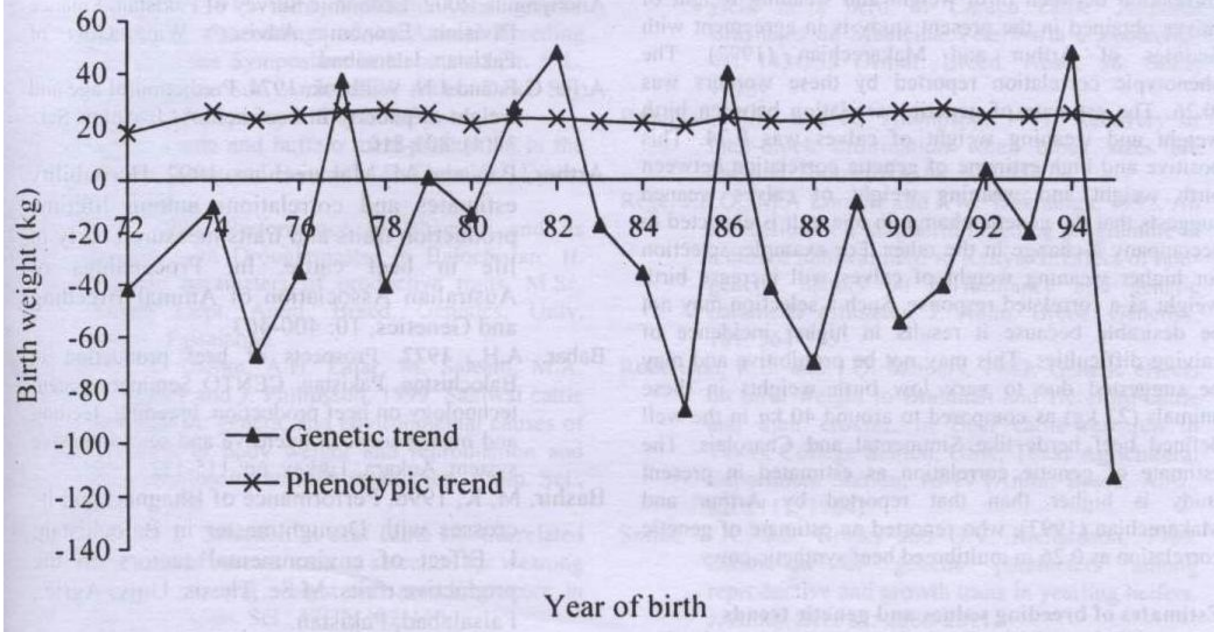
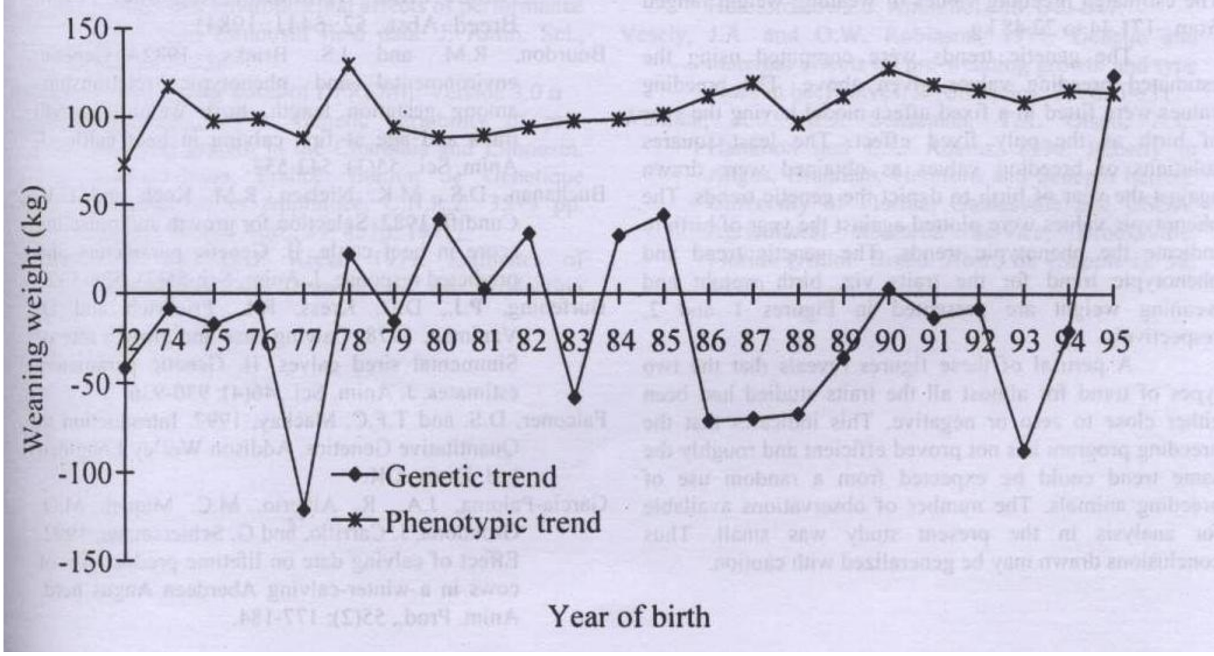


Fig. 2: Phenotypic and genetic trend for weaning weight



Correlations

The phenotypic and genetic correlations between birth weight and weaning weight of calves weaned were -0.23 and 0.74, respectively. The estimate of phenotypic correlation between birth weight and weaning weight of calves obtained in the present study is in agreement with findings of Arthur and Makarechian (1992). The phenotypic correlation reported by these workers was -0.26. The estimate of genetic correlation between birth weight and weaning weight of calves was 0.74. This positive and high estimate of genetic correlation between birth weight and weaning weight of calves weaned suggests that the genetic change in one trait is expected to accompany a change in the other. For example, selection for higher weaning weight of calves will increase birth weight as a correlated response. Such a selection may not be desirable because it results in higher incidence of calving difficulties. This may not be prohibitive and may be suggested due to very low birth weights in these animals (23 kg) as compared to around 40 kg in the well defined beef herds like Simmental and Charolais. The estimate of genetic correlation as estimated in present study is higher than that reported by Arthur and Makarechian (1992), who reported an estimate of genetic correlation as 0.26 in multibreed beef synthetic cows.

Estimates of breeding values and genetic trends

Estimated breeding values were computed using animal model best linear unbiased prediction procedure. Breeding values were estimated for performance traits viz. birth weight and weaning weight. The estimated breeding values for birth weight ranged from –171.44 to 242.48 kg. The estimated breeding values of weaning weight ranged from –171.44 to 22.48 kg.

The genetic trends were computed using the estimated breeding values given above. The breeding values were fitted in a fixed affect model having the year of birth as the only fixed effect. The least squares solutions of breeding values as obtained were drawn against the year of birth to depict the genetic trends. The phenotypic values were plotted against the year of birth to indicate the phenotypic trends. The genetic trend and phenotypic trend for the traits viz. birth weight and weaning weight are presented in Figures 1 and 2, respectively.

A perusal of these figures reveals that the two types of trend for almost all the traits studied had been either close to zero or negative. This indicates that the breeding program has not proved efficient and roughly the same trend could be expected from a random use of breeding animals. The number of observations available for analysis in the present study was small. Thus conclusions drawn may be generalized with caution.

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