Estimated of Genetic Parameters of Growth "GOLPAYEGANIAN" Calves

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Abstract

Genetic parameters estimation of growth traits is essential for breeding program. Birth weight(BW), weaning weight(WW), 6month weight (6MW), 12month weight(12MW), 15month weight (15MW) and 18 month weight(18MW), on 1662 Golpayeganian calves which had been collected during the 1989 to 1998 in Golpayegan, Deligan and Resalat Research Station. Data analysed with least square method for estimating the effects of some environmental factors, genetic and phenotypic parameters. Year of birth, season of birth, number of calving and sex of calf had significant effects on some traits.

Heritability estimates from the paternal half sib correlation were 0.29 ± 0.08, 0.39 ± 0.01, 0.40 ± 0.03, 0.48 ± 0.07, 0.48 ± 0.06 and 0.42 ± 0.06 for BW, WW, 6MW, 12MW, 15MW and 18 MW respectively.
Genetic and environmental correlations between traits were positive and significant. Results of this research indicate the ideal age of selection for growth traits in this breed is six month.

Key words: Genetic parameter, Environmental factors, Golpayeganian breed

Introduction

The genetic characteristics of native breeds are important, not only for conservation purposes but also for definition of breeding objective and breeding programs. When records are nonexistent and breeds are not well defined in the field, information could be obtained from research station information where pedigree and performance records have been kept. Various growth traits are major economic traits for both terminal sire and dual purpose breeds.
When body weights and growth rate to weaning in cattle are included in the breeding goal, it is usual to distinguish between genetic and permanent environmental components due to the dam in order to achieve optimum genetic progress. Golpayegan's is an Iranian native cattle.
They are very few studies using appropriate models to estimate the importance of genetic and phenotypic effects on growth traits. Recent developments in statistical methods for estimation of variance components have simplified the partitioning of variance and as linear models used in animal genetic evaluation make these effects can be included in BLUP analysis.

Materials and methods

The data used in this study consisted of growth records of calves in 3 herds of Golpayeganian cow. These data collected from records of the Delijan, Resalat and Golpayegan Research Stations, from 1989 through 1998. A total of 1662 records were available and thus analyzed for genetic and phenotypic parameters.

Body weights analyzed included weight at birth (BW), at 3 months or weaning weight (WW), at 6 months (6MW), at 9 months (9MW), at 12 months or yearling (12MW) and 18 months (18MW). Adjustment for fixed effects (sex, season of birth, year of birth, number of calving and herd) was achieved by including them in the model. Calves were separable by their dams in 3 days after birth. Each calf record included sire, dam, number of calving, gestation length, dam weight after calving, calve identifications, sex and four seasons of birth. Genetic and phenotypic parameters estimated were heritability of each trait, genetic and phenotypic correlations among some of these traits as traits of the calves.

Statistical analyses

Variance and (co)variance components for birth weight (model 1) and for all other weights (model 2) were estimated utilizing mixed-model, least-squares procedures. The following basic linear model was utilized:

$$Y_{ijkmnpw} = \mu + a_i + b_{j(i)} + c_k + d_m + f_n + h_p + b_{1k}GL + b_{2k}DW + e_{ijkmnpw} \qquad \text{(model 1)}$$
$$Y_{ijkmnpw} = \mu + a_i + b_{j(i)} + c_k + d_m + f_n + h_p + b_{3k}OW + e_{ijkmnpw} \qquad \text{(model 2)}$$

Where:

$Y_{ijkmnpw}$ the ijkmnpwth observation;

μ= an underlying constant for the trait;

a_i = fixed effect of the ith herd (i=1, 2, 3);

$b_{j(i)}$ = random effect of the i th sire (i=1, ...,33) nested within ith herd;

c_k= fixed effect of the kth year of birth (k=1, …,10);

d_m= fixed effect of the mth season of birth (m=1, 2, 3, 4);

f_n = fixed effect of the nth sex (1 =male, 2=female);

h_p = fixed effect of the pth number of calving (p=1, …,10);

b_{1k} to b_{3k} = regression coefficients for the k_{th} weight;

GL= the gestation length;

DW =dam weight after calving;

OW= birth weight;

$e_{ijkmnpw}$ = random error associated with the ijkmnpwth observation; In the models, $b_{j(i)}$ and $e_{ijkmnpw}$ were assumed to be uncorrelated random variables with zero means.

Gestation length and dam weight after calving was treated as a covariate in the model 1.
Gestation length and dam weight after calving and birth weight was treated as a covariate in the model 2.

Parameters were estimated from co-variances of relatives using paternal half-sib (PHS) analysis based on the Least Squares Method (Harvey, 1982). Heritability was estimated from variance components as

$$h^2 = 4c^{2}{}_{S} / c^{2}{}_{S} + c^{2}{}_{W}$$

Where:
h^2 = heritability estimate
$\acute{c}^{2}{}_{S}$ = sire variance component
$\acute{c}^{2}{}_{w}$ = variance of records within sires

The approximate method of Swiger et al (1964) was used to estimate the standard error of the heritability estimate. Genetic correlations between two traits 1 and 2, r_{12} were estimated as

$$r_{12} = \quad s_1 s_2 / (\quad s_1 \quad s_2)$$

Where:

$s_1 s_2$ is the sire covariance component for the two traits and s_1 and s_2 are square roots of respective sire variance components.

Sources of variation, appropriate degrees of freedom, and expected mean squares for random effects and fix effects are presented in table 1.

Table1: Analysis of variance for Birth weight (BW), weaning weight (WW), 6 month weight (6MW), 12 month weight (12MW), 15 month weight (15MW) and 18 month weight (18MW) traits

Trait	BW		WW		6MW		12MW		15MW		18MW	
Source of variation	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom	Mean square	Degrees of freedom
Herd	1.04963^{ns}	2	3335.62**	2	6821.05**	2	11034.7**	2	1384.5**	1	176.123 ^{ns}	1
Number of calving	15.106**	9	108.559^{ns}	9	200.93^{ns}	9	314.44 ^{ns}	9	491.577^{ns}	9	553.012 ^{ns}	9
Year of birth	9.50681^{ns}	7	516.172**	8	1008.65**	8	2684**	7	4566.34**	7	4639.34**	6
Season of birth	15.5202*	3	82.4687^{ns}	3	639.726*	3	1837.51**	3	1326.65^{ns}	3	1656.94^{ns}	3
Sex of calf	151.03**	1	1128.4**	1	9753.75**	1	104471**	1	215736**	1	322599**	1
Sire(herd)	11.7623**	32	196.991**	58	477.417**	56	1801.49**	41	2318.88**	38	2663.62**	29
Birth weight	-	-	14986.5**	1	38575.7**	1	89013.5**	1	104418**	1	114230**	1
Gestation Length	198.256**	1	-	-	-	-	-	-	-	-	-	-
Dam weight after calving	170.749**	1	-	-	-	-	-	-	-	-	-	-
Error	5.7537	587	75.23	803	173.57	729	456.6	673	625.4	559	836.7	462
R2	0.40		*0.61*		0.61		0.70		0.70		0.72	
CV	14.86307		17.35048		*14.19204*		15.91840		14.85745		15.26084	

Ns = non significant
P < 0.05
P < 0.01

Results and discussion

Analysis of variance for all traits is found in the Table 1.

Effect of various factors

-*herd* effects were highly significant for all weights except 18 months

-*number of calving of dam* was a highly significant source of variation only for birth weight. Tended to agree with the findings of….

-*Year of birth* significantly affected all traits. Results reported by (Amna et al., 1992; Rico et al., 1987; Kars et al., 1987) showed a similar trend for year of birth.

-*season of birth* significantly affected all traits except 3MW, 15MW and 18MW months this result was less than those reported by (Mazouz et al., 1988; Jeon et al., 1992)

-*sex of calves* tended to agree with the finding of (Plasse et al., 1995; Dzama et al., 1994).

-*Regression on birth weight, gestation length and dam weight after calving:* the effect of birth weight was highly significant for 3MW, 6MW, 12MW, 15MW and 18MW. The linear regression of BW on gestation length and dam weight after calving was highly significant.

Genetic and phenotypic parameters

-*Heritability* estimates are summarized in Table 2 Heritability of birth weight was found to be 0.29±0.08. This estimate compares favourably with estimates of 0.17 (Basu, 1992) and 0.35 (Maciejwoski et al, 1982). The estimate for weaning weight was 0.39±0.01 which was lower than 0.56±0.21 (Mchau, 1988) and 0.38±0.18 (Tawonezvi, 1989). Heritability for six months weight was estimated at 0.40±0.03. Few studies have reported heritability estimates of six months weight. 0.32 (Mahadevan, 1966) and 0.29 (Meyer and Syrstad, 1991) The estimate for weight at12-months weight was estimated at 0.48±0.07 and was higher than values reported in other studies 0.24 (Mchau, 1988); 0.26±0.11 (Meyer, 1991); and 0.22±0.11 (Wilton et al, 1986).the estimate for weight at 15 months 0.48±0.06 compares favourably with the range of 0.63 (Henderson et al, 1985); and 0.34 (Rico and Planas, 1994). Heritability at 18 months was found to be 0.42±0.06 this was slightly above the estimates of 0.48 (Mpiri, 1987).

Table 2: Heritabilities from paternal half-sib analyses (Golpayeganian Calves).

$h^2 \pm se$	Traits
0.29 ± 0.08	BW
0.39 ± 0.01	WW
0.40 ± 0.03	6MW
0.48 ± 0.07	12MW
0.48 ± 0.06	15MW
0.42 ± 0.06	18MW

BW = birth weight

WW = 3 months weight (weaning weight)

6MW = 6 months weight

12MW = 12 months weight (yearling weight)

15MW = 15 months weight

18MW = 18 months weight

-*Correlation* has been estimated only for BW, WW, 12MW, 15MW 18MW because in other weights the observation were not enough. Genetic correlation between growth traits at various ages was not generally high but was positive ranging from 0.10±0.29 to 0.42±0.21 (Table 2). Genetic correlations between trait weights were generally slightly above the estimates reported in the literature: 0.36 for correlation between birth weight and weaning weight and 0.32 for birth weight and12-months weight (Aman et al, 1985). 0.48 for birth weight and weaning weight (Ahunu et al, 1977). The estimate for correlation other cases shown in Table 3 and 4.Statistically in all case of the estimates were significantly different from zero. There is therefore, potential for exploiting correlated response for these traits.

Phenotypic correlations between weights were all positive and generally high (0.37-0.53) (Table 3 and 4) In all cases, estimates of phenotypic correlations were slightly smaller than the corresponding genetic correlation estimates (Malau et al, 1996).

<u>Tables 3 and 4: genetic and phenotypic correlations from paternal half-sib analyses (Golpayeganian Calves).</u>

Traits	BW	WW
BW		0.29[a] 0.27
12MW	0.26 0.26	0.36 0.21
15MW	0.11 0.29	0.28 0.23
18MW	0.10 0.29	

a: Genetic correlation with standard errors. b: Phenotypic correlation

Conclusion

From the results of this study' it is concluded that the ideal age of Preliminary selection for growth traits in this native breed in Esfahan province is six month. Positive correlated response should be expected in other correlated traits due to the generally large and positive genetic correlations.

References

Aman, A., K. Kamal, O. Arief and O. Shokr. 1985. Variation in weights of Kedahkelantan cattle from birth to one year of age. Animal Research Division, MARDI, Sungai Baging, Kuantan, Phang, Malaysia.13: 81-89.

Dzama, K., J. Baker, T. Cartwright and F. Ruvuna. 1994. Effect of age of dam on heterosis expression for growth traits in cattle. J. zimbabwe Society for Animal pro. 2: 81-85.

Jeon, G., K. Min, H. Kim, N. Kim, and K. lee. 1992. Effect of mating systems on the body weight of crosses between Korean native and Charolais cattle. Research Reports of the Rural Development Administration livestock. 34: 6-12.

Juma, K., H and S.H. Jajo. 1988. Evaluation of factors affecting birth weight in Friesian cattle. 3rd world congress on genetic applied to livestock production. Lincoln. Nebraska. USA: 535-538.

Kars, A., G. Erasmus and J. V. Westhuizen. 1994. Factors influencing growth traits in the Nguni cattle study at Bartlow combine South African. J. Anim. Sci. 66: 2167-2178.

Maciejwoski, J and J. Zieba. 1982. Genetics and Animal Breeding. Elsevier Scientific Publishing Company.

Mahadevan, P. 1966. Breeding for milk production in tropical cattle.

Malau, A.A., B. Abubakar and N. Dim. 1996. Studies on milk production and growth of Friesian x Bunagi crosses growth to yearling age. Asian Australasian J. Anim. Sci. 9: 509-513.

Henderson, C. R. 1985. MIVQUE and REML estimation of additive and non-additive genetic variances J. Anim. Sci. 61:113-120.

Mpiri, D. B. 1987. Factors affecting the performance of Mpwapwa cattle in Mwanza region in Tanzania. Bulletin Anim. Health pro. 35:136-143.

Mazouz, A and A. Asri. 1988. Age and body weight of Moroccan local cattle at puberty of season. Isotope aided studies on livestock: 221-230.

Mchau, K. W. 1988. Production characteristics at Mpwapwa cattle. Lactation yield and length. world Anim. Rev.65: 11-16.

Meyer, K. W and O. Syrstad. 1991. Production characteristics of Mpwapwa cattle. Shape of the lactation curve. world Anim Rev. 66: 49-54.

Basu, S. B.1985. Genetic Improvement of Buffaloes. Pub. Company Inc. New York.

Rico, C and T. Planas. 1994. Environmental and genetic influences on Zebu development. Cuban Journal of Agricultural Sci. 28: 269-275

Tawonezvi, H. 1989. Growth of Mashona cattle on range in Zimbabawe, Environmental influences on live weight and weight gain. Tropical Anim. Health. Pro. 21: 37-42.

Wilton, J. IV., J. Mcwhir, G. K. Macleod and G. J. King. 1986. Genotype-nutrition interaction for reproduction of beef cows. J. Anim. Sci. 67: 789-800.