ESTIMATES OF GENETIC PARAMETERS OF SOME GROWTH TRAITS IN JERSEY CATTLE

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Summary

Data from 178 Jersey calves born at Livestock Experiment Station were analyzed to obtain estimates of heritability, genetic and phenotypic correlations of some growth traits. Sex-specific variance and covariance components were estimated for birth weight (BWT), 180-d weight (WWT), 365-d weight (YWT), birth to weaning daily gain (BWG), weaning to yearling daily gain (WYG) and birth to yearling gain (BYG). Heritabilities, genetic and phenotypic correlations were generally higher in males than females. Heritabilities estimated for males and females respectively were 0.98 and 0.49 for BWT; 0.70 and 0.76 for WWT; 0.71 and 0.26 for YWT. Genetic correlations were higher than phenotypic correlations in all the traits studied.

(Key Words : Genetic Correlation, Phenotypic Correlation, Growth, Jersey Cattle)

Introduction

Growth traits are desirable economic parameters and integral part of the profit-loss equation in livestock production. Faster growth rate increases the production of feed intake for tissue synthesis and reduces total inputs per unit of weight gain (Koch et al., 1982). Rapid weight gain is also important for early maturity in dairy cattle. Breeding procedures to improve the rate of weight gain and growth rate of animals largely depend on heritabilities and correlations among various growth parameters at different stages of age (Alenda and Martin, 1987).

Considerable research efforts have been directed towards estimating genetic parameters for various growth traits in beef cattle. However, the majority of the estimates available in the literature are based upon records obtained on British-type cattle. In contrast, only limited effort has been made for estimating genetic parameters in other cattle breeds (Aaron et al., 1987). Because genetic parameters are specific for a particular population, estimates of genetic parameter from one breed may not be appropriate when applied to other breeds (Aaron et al., 1987).

The objectives of this study were; (1) to estimate heritabilities, genetic and phenotypic correlations of weight and gain traits between birth and one year of age and (2) to evaluate the inheritance pattern for various growth and weight traits in Jersey and compare them with those reported in the literature for other breeds. Consequently the information will help in formulation of breeding plans for early maturity of Jersey cattle especially in tropical and sub-tropical regions.

Materials and Methods

The data were obtained from the Jersey cattle maintained as nucleus herd at the Livestock Research Station, Animal Sciences Institute, National Agricultural Research Centre, Islamabad. The herd was fed on seasonal green fodder and limited grazing supplemented with concentrate ration according to their maintenance and production requirements. Cows were artificially bred using semen of Jersey bulls, the calves were born throughout the year and weaned at approximately 180-d.

The data were obtained from individual animal record on birth weights (BWT), weaning weights (WWT), yearling weights (YWT), birth to weaning daily gain (BWG), weaning to yearling daily gain (WYG), birth to yearling daily gain (BYG), season of birth and sex of 178 cattle born between 1985 to 1992.

The data were analyzed using MSTATC statistical package. The models used for analysis included the effects of dam, progeny, season of birth and sex of the calf. Since the effects of later two effects were found to be non-

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significant, they were excluded from the subsequent models. Descriptive statistics on various growth traits are in table 1. Genetic parameter estimates were obtained using maternal half-sib techniques described by Falconer (1981). Heritability (h^2) estimates for growth traits were calculated using the following formula:

$h^2 = 4\sigma^2_D / (\sigma^2_D + \sigma^2_e)$

Where, σ^2_D and σ^2_e are the estimates of the dam variance component and the residual variance component respectively. Estimates of genetic correlations (r_g) of the traits were calculated as follows;

$r_g = \sigma_{DxDy} / (\sigma^2_{Dx} \times \sigma^2_{Dy})^{0.5}$

Where, σ_{DxDy} is the estimated dam covariance components for traits x and y, and σ^2_{Dx} and σ^2_{Dy} are the estimated dam variance components for traits x and y, respectively. Estimates of phenotypic correlations (r_p) were calculated using the following formula:

$r_p = [\sigma_{DxDy} + \sigma_{exey}] / [(\sigma^2_{Dx} + \sigma^2_{ex})\ (\sigma^2_{Dy} + \sigma^2_{ey})]^{0.5}$

TABLE 1. DESCRIPTIVE STATISTICS ON GROWTH TRAITS OF JERSEY CATTLE (kg)

Trait	Mean	SD
Birth wt		
Male	24.297	4.186
Female	23.851	4.299
Combine	24.079	4.235
Weaning wt		
Male	129.967	21.480
Female	129.471	23.508
Combine	129.725	22.432
Yearling wt		
Male	206.549	25.749
Female	206.540	37.555
Combine	206.545	31.975
Birth to weaning gain per day		
Male	1.195	0.273
Female	1.181	0.248
Combine	1.188	0.261
Weaning to yearly gain per day		
Male	0.285	0.273
Female	0.286	0.248
Combine	0.286	0.106
Birth to yearling gain per day		
Male	0.491	0.080
Female	0.497	0.106
Combine	0.494	0.093

Where, σ_{DxDy} and σ_{exey} denote the estimated dam and residual covariance components for traits x and y respectively; σ^2_{Dx} and σ^2_{ex} are the estimated dam and residual variance components for traits x and σ^2_{Dy} and σ^2_{ey} are the estimated dam and residual variance components for trait y.

Results and Discussion

Variance Components

Estimates of σ^2_D and σ^2_e variance components, for BWT, WWT and YWT by sex are in table 2. For BWT, the dam variance component was approximately twice as large for males as for females (4.87 vs 2.3 kg^2). The dam component accounted for 4.08 and 12 percent of total variation in BWT for males and females respectively. For WWT, there was no difference in the dam variance component for males (74.79 kg^2) and females (75.35 kg^2). Similar results were reported by Aaron et al. (1987). Thrift et al. (1981) reported that the sire component for BWT was slightly larger for females than for males in Hereford and Angus cattle and just the reverse for WWT. This difference in part may be due to the dam component used in the present study as compared to sire component used by Thrift et al. (1981). The other reason could be due to the breed differences in these studies, i.e. beef vs dairy.

TABLE 2. VARIANCE COMPONENTS (kg^2) AND PERCENTAGES OF TOTAL VARIANCE CALCULATED BY SEX AND COMBINED ACROSS SEXES

Item	Dam component	Percent of total	Residual component	Percent of total
Males				
Birth wt	4.87	4.08	15.00	95.92
Weaning wt	74.79	17.44	353.85	82.56
Yearling wt	120.53	18.00	552.43	82.00
Females				
Birth wt	2.39	12.00	17.15	88.00
Weaning wt	75.35	19.12	318.62	80.87
Yearling wt	71.10	7.00	1,002.58	92.00
Combined				
Birth wt	3.50	19.00	15.08	81.00
Weaning wt	183.17	38.00	303.56	62.00
Yearling wt	164.46	18.00	740.91	82.00

Heritabilities

The h^2 estimates for growth traits are presented in table 3. Heritability estimates for BWT in males was higher than females (.98 vs .49), and were in accordance with earlier reported results in beef breeds. (Knight et al., 1984; Nelson et al., 1986; Koch et al., 1973; and Alenda and Martin, 1987). Other studies (Bourdon and Brinks, 1982; Denise et al., 1988) reported comparatively low h^2 for BWT. (.43 in males and .35 in females). The h^2 estimates reported herein and by other workers indicate that the trait will positively respond to selection.

TABLE 3. ESTIMATES OF HERITABILITIES AND GENETIC AND PHENOTYPIC CORRELATIONS BY SEX COMBINED ACROSS SEXES

Trait	Birth wt	Weaning wt	Yearling wt
Birth wt			
Males	0.98	0.19	0.42
Females	0.49	0.26	0.26
Combined	0.75	0.23	0.32
Weaning wt			
Males	0.15	0.70	0.42
Females	0.17	0.76	0.55
Combined	0.13	0.84	0.49
Yearling wt			
Males	0.30	0.32	0.71
Females	0.14	0.43	0.26
Combined	0.21	0.33	0.73

Heritabilities are on the diagonal, genetic correlations above and phenotypic correlations below the diagonal.

The h^2 estimates for WWT were comparatively lower in males than the females (.70 vs .76). This trend was similar to that reported by Aaron et al. (1987). Although, their values for h^2 estimate for this trait (.43 for males vs .33 for females) were relatively lower compared to those reported in present study. The h^2 estimates for YWT in males and females were .71 and .26 respectively. Alenda and Martin (1987) also reported that h^2 estimates in males was almost double than that of females. This indicate that males will respond more to selection than females for higher YWT.

Heritability estimates derived from the dam component in this study were higher for all the traits compared to those reported by Aaron et al. (1987), using sire component. This may be due to the fact that the dam component containing all variances due to her maternal ability, dominance and epistasis, inflating the numerator.

Correlations

Estimates of genotypic and phenotypic correlations for BWT, WWT, and YWT are presented in table 3. The genetic correlation between BWT and WWT was .19 and .26 for males and females respectively, these results are contrary to those reported previously (Alenda and Martin, 1987; Aaron et al.; 1987), who reported higher but non-significant estimates for males than females for this parameter.

The genetic correlation between BWT and YWT in males and females was .42 and .26 respectively. Similar estimates have been reported previously (Nelson et al., 1986; Knights et al., 1984; Thrift et al., 1981). The genetic correlation between WWT and YWT in males and female were .42 and .55 respectively, indicating strong correlation between these two traits. These results confirmed the earlier findings in beef breeds (Nelson et al., 1986; Eisen and Prasteyo, 1988; Koch et al., 1982; Bourden and Brinks, 1982).

Estimates of phenotypic correlations are presented in table 3. The estimates of these parameters were significantly different between the two sexes and generally higher for female than males. Also, these figures were slightly smaller than the corresponding genetic correlations.

Conclusion

The heritability estimates obtained for different growth traits by maternal half-sib methods in Jersey cattle were found to be fairly high. The estimates suggest that growth traits are controlled by additive genes in dairy cattle as well. Selection, therefore may be the answer for improving growth related traits in Jersey cattle as much as in any other breeds of cattle. However, there was low genetic and phenotypic correlation among growth traits, indicating, selection for one may not improve the other traits.

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