GENETIC PARAMETERS OF BODY WEIGHT AND MEASUREMENTS IN HOLSTEIN FRIESIAN X GIR AND JERSEY X GIR CROSSES[1]

GENETISCHE PARAMETERS DER KOERPER-GEWICHTE UND MASSEN IN HOLSTEIN FRIESIAN X GIR UND JERSEY X GIR KREUZUNGEN[1]

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The genetic parameters like heritability and genetic correlations are must for any breeding and selection programme. The estimates of heritability indicate the extent to which reliance can be placed on genetic transmission as observed from phenotype. While the genetic correlations help the breeder to develop index for selection by incorporating the genetically correlated traits along with the help of h^2 estimates.

Heavier body weights and higher measurements reflect the better growth in animals which inturn helps in attaining early sexual maturity and more physiological capacity to produce more milk. There are only few references available on genetic parameters of growth traits in dairy crossbreds.

The halfbreds produced under All-India Coordinated Research Project on Cattle Breeding are going to form a base for development of a future breed of the area. Hence the early economic traits on animal like body weight and measurement needs to be genetically evaluated.

MATERIAL AND METHODS

The body weights and measurements like heart girth (HG), wither height (WH) and body length (BL) recorded on 202, 1/2 Holstein1/2Gir (1/2H1/2G) and 97, 1/2Jersey1/2Gir (1/2J1/2G) crossbred females at 0,3,6,9,12 and 15 months of age during 1973 to 1978 were analysed for non_genetic and genetic sources by using mixed model. The model included fixed effect due to year of birth, season of birth, and breed group with sire effect as random. The least-square constants (Harvey, 1960) for fixed effect were obtained and the data for respective age were adjusted by respective age groups so that the adjusted dependent variable was $Y_{ij} = u + S_i + e_{ij}$. The analysis of variance was done to get sire variance component for the adjusted data. The heritability estimates were made. The standard error for the estimates were made using statistics of Swiger et al. (1964).

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The estimates for genetic, environmental and phenotypic correlations (r_g, r_e, r_p, respectively) were obtained from the variance and covariance analysis on the adjusted data. The standard error (SE) for the correlation estimates were obtained by the method suggested by Scheinberg (1966).

RESULTS AND DISCUSSION

The estimates of heritability for body weights and measurements at 0,3,6,9,12 and 15 months of age are presented in Table 1. There was an increasing trend in h^2 estimates for body weights as the age advanced. Similar increasing trend for h^2 in crossbred for advancing age has been reported by Rao and Nagarcenkar (1978). However, Parekh *et al*. (1976) and Taneja and Bhat (1970) did not find any definite increasing trend of h^2 for advancing age. These results indicate the concept of modifying genes for the body weight which express themselves at later age intervals. Here, modifying gene action seems to express itself upto the age of 12 months where the h^2 was maximum (0.63 ± 0.29). The estimates reported (Table 1) for body weights were higher than the earlier estimates (Naidu and Desai, 1970; Taneja and Bhat, 1970; Parekh *et al*., 1976) in crossbreds.

Significant h^2 estimates obtained were at the age of 9 and 12 months; indicating that selection could be practiced for heavier weight at 12 months of age.

The h^2 estimates for body measurements at birth (0) were negative, indicating larger error involved in recording. The only realistic estimates at birth recorded was for BL indicating that error involved in recording BL was low. None of the h^2 estimates for body measurement (BW, HG, WH, BL) were significant even at later age (Table 1) except for HG at 12 months (0.6 ± 0.25). These estimates were lower than those reported by Blackmore *et al*. (1958) and Brum and Ludwick (1969) for purebreds. From the results (Table 1), it is apparent that in these crossbreds the h^2 estimates for muscular growth (BW and HG) were higher than skeletal growth (WH and BL), at different intervals from 3 to 12 months of age. However, in purebred Holstein, Touchberry (1951), Blackmore *et al*. (1958) and Brum and Ludwick (1969) reported higher estimates for wither height than for body length and hear girth.

Correlations : The r_g, r_e, r_p between body weights and measurements as well as between various body measurements at different age intervals are presented in Table 2. From the results it is apparent that many of the r_g exceeded the normal range while in others the estimates could not be arrived at, which was either due to negative sire component of variance or due to larger sampling error.

The magnitude of r_g obtained at 9 and 12 months of age suggest that genetic values for body weight and body measurements are interwoven and show much dependence on each other. However, these interwoven knots cannot be pulled apart due to many unrealistic estimates. No doubt, additional data involving larger number of progenies per sire would seem to be necessary to solve the puzzle.

TABLE 1

Heritability for body weight and various body measurement at various age intervals in crossbreds

Characters	Age at birth	3 months	6 months	9 months	12 months	15 months
BW	0.2±0.15	0.4±0.19	0.6±0.23	0.6±0.22	0.6±0.29	0.1±0.14
HG	-0.2±0.07	0.4±0.19	0.2±0.16	0.4±0.19	0.6±0.25	0.03±0.13
WH	-0.2±0.06	-0.1±0.09	0.2±0.15	0.1±0.14	0.2±0.16	0.3±0.20
BL	0.3±0.18	0.2±0.16	-0.03±0.10	0.2±0.15	0.2±0.16	0.1±0.14

BW - Body weight
HG - Heart girth
WH - Wither height
BL - Body length

TABLE 2

Genetic, environmental and phenotypic correlations (r_g, r_e, r_p) between body weights and body measurements at various age intervals in crossbreds

Age in months	Type of correlation	BW : HG	BW : WH	BW : BL	HG : WH	HG : BL	WH : BL
0 (birth)	r_g	a	a	-1.0±0.66	-1.5±0.50	-0.1±0.76	a
	r_e	0.9±0.08	0.8±0.06	0.8±0.18	0.7±0.04	0.7±0.01	0.8±0.11
	r_p	0.6±0.06	0.5±0.05	0.3±0.09	0.6±0.06	0.6±0.04	0.3±0.07
3	r_g	a	a	0.2±0.53	0.2±0.90	a	a
	r_e	0.6±0.08	0.1±0.07	0.3±0.12	0.2±0.04	0.5±0.08	0.3±0.07
	r_p	0.6±0.05	0.5±0.10	0.5±0.03	0.5±0.05	0.5±0.06	0.5±0.05
6	r_g	-0.04±0.43	0.3±0.40	a	0.1±0.37	a	a
	r_e	1.1±0.55	0.9±0.18	0.9±0.18	0.8±0.06	0.7±0.06	0.8±0.05
	r_p	0.5±0.09	0.5±0.14	0.5±0.07	0.8±0.02	0.8±0.03	0.7±0.05
9	r_g	1.0±0.07	0.9±0.29	1.1±0.17	0.9±0.27	1.0±0.17	1.3±0.42
	r_e	0.7±0.11	0.8±0.08	0.6±0.09	0.7±0.07	0.6±0.09	0.7±0.06
	r_p	0.8±0.02	0.7±0.04	0.6±0.46	0.7±0.04	0.6±0.05	0.6±0.03
12	r_g	1.0±0.06	1.1±0.26	1.0±0.28	1.0±0.25	1.0±0.21	1.6±0.49
	r_e	0.8±0.10	0.4±0.12	0.4±0.12	0.5±0.15	0.8±0.12	0.1±0.10
	r_p	0.8±0.03	0.7±0.02	0.6±0.05	0.6±0.06	0.7±0.05	0.5±0.07
15	r_g	1.7±2.94	1.3±1.21	-0.7±2.23	0.8±0.94	1.1±0.42	0.5±1.05
	r_e	-0.04±0.56	0.0	0.3±0.23	0.8±0.07	0.3±0.09	0.4±0.22
	r_p	0.2±0.31	0.5±0.20	0.3±0.23	0.7±0.04	0.4±0.01	0.1±0.06

r_p - Phenotypic correlation; r_e - Environmental correlation

r_g - Genetic correlation; a - Variance component negative and hence r_g not calculated.

The r_p between body weight and different body measurements, starting from birth to 12 months of age were higher in magnitude with an increasing trend with advancing age (Table 2). These higher correlations (r_p) were expected as the body weight and measurements are indicator of size. These r_p reported here were higher than those reported by Taylor (1953) in Holstein x Red Sindhi crosses, Agasti *et al.* (1974) in Jersey x Hariana crosses but were lower than those reported for purebred Holstein (Touchberry, 1951).

High phenotypic correlation between body weight and body measurements indicates that body measurement could serve as a suitable phenotypic indicator for body weights. However, non-significant although high genetic correlation warrants its use in selection programme for heavier body weights.

The r_e between BW and body measurements were all high (Table 2) from birth to 15 months of age. This indicates that there were larger environmental influences affecting these traits in same direction. This could be one of the reasons for high standard error for the r_g.

SUMMARY

The body weights and body measurements from birth to 15 months of age on 202, Holstein x Gir (1/2H1/2G) and 97, Jersey x Gir (1/2J1/2G) females, over a period of 1973-78, were analysed for genetic and non-genetic source of variance by least-square technique.

The h^2 estimates, after adjustment for non-genetic sources, were significant at 6,9, and 12 months and were 0.6 ± 0.23, 0.56 ± 0.22 and 0.63 ± 0.29, respectively. The increasing trend of h^2, as the age advanced was observed upto 12 months of age. No definite trend for wither height and body length was observed. However, increasing trend of h^2 were recorded for heart girth from 6 months onward with significant estimate (0.6 ± 0.27) at 12 months.

The r_g between body weight and heart girth at 9 and 12 months of age were 0.95 ± 0.07 and 0.95 ± 0.06. All the r_p and r_e between body weights and measurements were positive, high and showed increasing trend with advancing age from 0 to 15 months.

ZUSAMMENGASSUNG

Die Koerpergwichte und die Koerpermaszen von Gaburt bis zum 15 monatiger Alter in 202, Holstein x Gir (1/2H1/2G) und 97, Jersey x Gir (1/2J1/2G) weibliches Geschlechts wurden in dem Zeitraum von 1973 bis 1978 Analysiert, fuer die Genetische und nicht Genetische Quellen. Die Analyse wurde durch die mindest Quardrat-Methods vollzogen.

Die h^2 Schaetzugen waren, nach Anpassung der nicht Genetische Quellen signifikant, in dem Alter von 6,9,12 Monate und waren 0.6 ± 0.23, 0.56 ± 0.22 und 0.63 ± 0.29 der Reihe nach. Der Vergroeszerungstrend des h^2 wurde gemerkt mit zunehmendam Alter bis zu 12 monaten. Kein fester Trend in der Widerrist Hoeche oder lagnge des Koerpers wurde festgestellt, jedoch Wachstums

In second generation three-bred cross genetic group, a significant ($P < 0.01$) Hb type difference for age at puberty was recorded in 1/2J1/4H1/4G genetic cross indicating Hb-A superiority over heterozygotes (Table 3). No difference between Hb type for different economic traits was recorded in 1/2H1/4J 1/4G cross. Similar non-significant difference for Hb type was recorded in 1/2BS1/4H1/4G cross. Although there was a significant difference between Hb type for age at first calving and frequence of ailment, in 1/2J1/2G a poor association for the traits were recorded. This also indicates a high C.V. for the traits (> 15% and > 70%, respectively). However, a fair association for fat% was recorded indicating homozygous advantage. In 1/2H1/2G cross almost all the traits showed a very poor association with Hb type. Similar non-significant association were reported by many workers (Schreffler and Salisbury, 1959; Balakrishnan and Nair, 1966 and Solanki and Shukla, 1979, 1980). However, there are several reports indicating association between Hb types and some of the economic traits like fat%, milk constituent, body weight, birth type, lactation yield, age at first calving and production and sexual puberty. However, good association between Hb type and 300 days milk yield in 1/2J1/4 H1/4G, SNF% in 1/2H1/4J1/4G and frequency of ailment in 1/2BS 1/4H1/4G was recorded which appears to be due to small sample size. This needs to be investigated in details. Similarly for association for many traits in different three-breed crosses need to be investigated in more details as no much reliance can be put due to small sample size in each three-breed cross.

SUMMARY

Total 243 halfbreds and 57 three-fourth-breds generated under All-India Coordinated Research Project on Cattle at Jabalpur were screened for haemoglobin types. The gene frequency in halfbreds for Hb-A was 0.695. The 1/2Holstein1/2Gir (1/2H1/2G) did not exhibit any Hb-BB genotype while 1/2Jersey 1/2Gir (1/2J1/2G) exhibited 13% individuals. The Hb-A frequency was 0.751 in 1/2H1/2G, 0.577 in 1/2J1/2G and 0.7771 in 3/4-breds. All breed groups were in genetic equilibrium except 1/2H1/2G.

A significant heterozygous advantage was recorded for age at first calving and frequency of ailment in 1/2J1/2G. Fair association between Hb-types and fat% in 1/2J1/2G, and good association among Hb-type with 300 days milk in 1/2J1/4H1/4G, along with frequency of ailment in 1/2BS1/4H1/4G, was observed. Similar fair association was noticed for almost all the traits in different three-breed crosses.

ZUSAMMENFASSUNG

Insgesammt 243, 50% Mischlingstiere und 57, 75% Misclingstiere, erzeugt unter dem Projekt "All-India Coordinated Research Projekt on Cattle at Jabalpur" wurden untersucht fuer Haemoglobin typen. Das Gen haufigkeit in 50% Mischlingstiere fuer Hb-A war 0.695, Das 1/2Holstein1/2Gir (1/2H1/2G) zeigte keine Hb-BB Genotype an wohin-gegen 1/2Jersey1/2Gir (1/2J1/2G) zigtenk 13% individums. Das Hb-A Haeufigkeit war 0.751 in