

Growth performance of three- and four-breed crosses in dairy calves

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ABSTRACT

Data on body weight and growth rate from birth to 6 months of age on calves with 50 and 75% level of *Bos taurus* inheritance, resulting from 3- and 4-breed matings in a pilot crossbreeding project, are presented. The effect of genetic group was statistically significant. However, there was no significant difference in body weight at different ages of male and female calves. The calves of 1/2 Holstein-Friesian \times 1/4 Brown Swiss \times 1/4 Tharparkar genetic group were heaviest at all ages. There was some advantage with respect to early growth traits of 4-breed matings to obtain terminal cross calves. The trend revealed that calves sired by Holstein-Friesian bulls had a faster growth rate.

In the process of crossbreeding of cattle for increased milk production, significant improvement has been achieved by the production of F1's, possibly as a result of heterosis for various economic traits. To continue exploiting heterosis, rotational crossbreeding and multiple breed crosses are recommended (Hickman, 1979). This system of breeding is also advocated for evolving new breeds by combining desirable traits from a number of breeds (Humphrey, 1967).

MATERIALS AND METHODS

A pilot crossbreeding experiment was conducted at the National Dairy Research Institute (NDRI), Karnal, to study the performance for various economic traits as a result of crossbreeding between Tharparkar (T) as a *Bos indicus* female and Holstein-Friesian (H), Brown Swiss (B) and Jersey (J) as sires of *Bos taurus* species. The Institute obtained on transfer from the Indian Agricultural Research Institute, a group of Holstein-Friesian \times Sahiwal (HS) crosses during 1974. The experimental herd at the NDRI had already animals of Brown Swiss \times Sahiwal (BS) inheritance which were a result of the breeding experiments in progress for the past 15 years (Bhatnagar *et al.*, 1977). For the present studies, a trial was conducted to obtain a few 4-breed cross animals. Their performance was assessed for various economic traits. The

various genetic groups involved in the breeding experiments and their level of *Bos taurus* and *Bos indicus* inheritance are enumerated below (the first letter represents the breed of sire :

Breed	Nomenclature	Level of inheritance	
		<i>Bos taurus</i>	<i>Bos indicus</i>
BS \times HS	BHS	50	50
H \times BT	HBT	75	25
H \times JT	HJT	75	25
HT \times BS/BS \times HT	HTBS	50	50

The data on body weights from birth to 6 months of age on both male and female calves of 4-breed crosses HTBS and 3-breed crosses (BHS, HBT and HJT) born during 1976 and 1977 were used. Least-squares analysis (Harvey, 1966) was conducted after classifying the data according to year of birth, genetic group and sex of calf using the following model :

$$Y_{ijkl} = \mu + X_i + G_j + S_k + E_{ijkl}$$

where,

Y_{ijkl} is the body weight of l th calf of k th sex in j th genetic group from i th year.

μ is the overall mean, X_i , G_j and S_k are fixed effects due to year of

birth, genetic group and sex respectively; and

E_{ijkl} is the random error $N_{1D}(0, \sigma_2^2)$.

Least-squares genetic group means were compared using Kramer's modification of Duncan's multiple range test (Kramer, 1956). Differences due to breed of the sire used in obtaining the terminal calves in case of reciprocal matings in one genetic group were also studied.

RESULTS AND DISCUSSION

The least-squares analysis of variance to test the significance of different effects and least-squares constants for body weights at different ages are given in Tables 1 and 2.

Effect of years

Year of birth had no significant effect on body weights from birth to 1 month of age, but was statistically significant ($P < 0.05$) thereafter.

Sex of calf

There was no statistically significant difference in the body weights of male and female calves at all ages. Since all the calves were weaned at birth and raised under systematic management on rations according to their requirements, the variation observed in the growth rate of calves of the two sexes should not be large.

Genetic group differences

The effect of the genetic group on body weight was statistically significant from birth to 6 months of age (Table 1). The least-squares constants indicated that HBT calves were the heaviest at all ages and HTBS calves ranked next below them from birth to 3 months of age, when they were superseded by HJT calves. The HJT calves ranked next to HBT at 6 months of age. The difference between the mean body weight of calves of these two genetic groups were not statistically significant at that age. The difference in the weight between HBT and HTBS calves was not statistically significant at

Table 1. Least-squares analysis of variance for body weight of different genetic groups

	d.f.	Birth	2 weeks	1 month	2 months	3 months	4 months	5 months	6 months
Between year	1	8.15	13.10	30.47	406.89*	435.95*	896.92*	2161.12*	3555.33*
Between genetic groups	3	214.45*	270.86*	332.42*	347.26*	490.52*	264.38*	410.68*	968.58*
Between sexes	1	3.68	8.71	21.41	32.85	150.13	0.04	3.21	42.93
Error		18.23	12.20	12.55	33.37	54.37	77.98	102.74	106.42
		(210)	(165)	(169)	(160)	(143)	(128)	(112)	(93)

* $P < 0.05$.
 Figures in parentheses are degrees of freedom for error mean squares.

Table 2. Least-squares constants for body weight at different ages

Effect/Age	Birth	2 weeks	1 month	2 months	3 months	4 months	5 months	6 months
Mean (μ)	27.09	28.01	32.30	43.72	57.84	70.28	81.96	92.67
Years								
1976	-0.12	-0.23	0.36	1.61	1.79	2.71	4.53	6.30
1977	0.12	0.23	-0.36	-1.61	-1.79	-2.71	-4.53	-6.30
Genetic group of calf								
BHS	-0.65 ^{ac*}	-1.54 ^a	-2.52 ^a	-3.23 ^a	4.45 ^a	-2.66 ^a	-2.37 ^a	-6.53 ^a
HBT	2.20 ^b	3.01 ^b	3.64 ^b	3.81 ^b	4.85 ^b	4.31 ^b	5.84 ^b	9.29 ^b
HJT	-2.06 ^a	-2.24 ^a	-1.60 ^{ac}	-1.60 ^{ac}	-1.16 ^{ac}	0.17 ^a	-0.10 ^a	3.07 ^b
HTBS	0.51 ^{ba}	0.77 ^c	0.67 ^c	1.02 ^{bc}	0.76 ^{bc}	-1.48 ^a	3.36 ^a	-4.83 ^a
Sex								
Male	-0.13	0.23	0.23	0.36	1.13	0.02	-0.19	-0.85
Female	0.13	-0.23	-0.36	-0.16	-1.13	-0.02	0.19	0.85

*Means carrying different superscripts differ significantly ($P < 0.05$) from each other.

Table 3. Body weights of 4-breed (HTBS) crosses according to sex and breed of sire

	1/4HF + 1/4Th + 1/4BS + Sahi (HTBS)		Calves sired by	
	Female	Male	HT(1/2HF + 1/2Th) BS(1/2BS + 1/2Sahi)	
Birth weight	26.56 ± 1.39 (16)	28.76 ± 1.13 (13)	27.36 ± 1.08 (19)	27.9 ± 1.81 (10)
2 weeks	28.20 ± 1.19 (15)	29.75 ± 1.31 (13)	28.66 ± 0.78 (18)	29.4 ± 2.08 (10)
1 month	31.80 ± 1.20 (15)	33.84 ± 1.51 (13)	32.61 ± 0.92 (18)	33.00 ± 2.14 (10)
2 months	42.86 ± 1.59 (15)	44.30 ± 1.92 (10)	44.18 ± 1.47 (16)	43.5 ± 2.46 (8)
3 months	57.05 ± 1.76 (15)	58.60 ± 3.56 (5)	58.23 ± 2.04 (13)	56.14 ± 2.44 (7)
4 months	69.06 ± 1.70 (16)	63.66 ± 1.85 (3)	68.53 ± 1.96 (13)	66.14 ± 2.51 (7)
5 months	77.34 ± 1.94 (16)	72.33 ± 5.36 (3)	76.83 ± 2.37 (12)	76.07 ± 3.07 (7)
6 months	84.56 ± 2.24 (16)	96.00 ± 4.00 (2)	84.83 ± 2.85 (12)	87.83 ± 3.48 (6)

Figures in parentheses indicate number of observations.

birth, and 2 and 3 months of age. Calves of HJT group were significantly lower in body weight at birth, 2 weeks and 1 month of age than HTBS calves, but were significantly heavier at 6 months of age, the difference in the intervening period, i.e. from 2 to 5 months, being not significant statistically. This revealed that though HJT calves had lowest body weight at birth, they had a better growth rate and

hence were able to surpass HTBS and BHS group calves at later ages to rank next to calves of HBT group. The growth data in general revealed highest gain in weight among calves of all genetic groups between the age of 2 and 3 months. The BHS group calves ranked lowest, except at 5 months of age when they were superior to HTBS calves. When the data on calves of these genetic groups accor-

ding to the *B. taurus* inheritance was considered, HBT and HJT groups with 75% exotic level differed significantly ($P < 0.05$) from each other at all ages except at 6 months of age. The calves of HBT group were heavier in weight throughout. When BHS and HTBS groups having 50% level of exotic inheritance were compared, HTBS calves had higher body weight at all ages except at 5 months of age, the difference in the means of the two groups being statistically significant at all ages except at birth, and 4, 5 and 6 months of age. This leads to surmise that 4-breed crosses had some advantage in growth rate at younger age. As can be seen from the data presented herein, both the genetic groups compared had similar level of inheritance from the two *B. taurus* breeds Brown Swiss and Holstein-Friesian, but one of these (BHS) had only one *B. indicus* breed component, i.e. Sahiwal, whereas the other (HTBS) had two *B. indicus* breed components, viz. Sahiwal and Tharparkar. The overall trend from the data on the 4 genetic groups revealed that calves sired by Holstein-Friesian breed were superior in growth rate. Since the HTBS group had certain calves sired by HT and others by BS bulls, discussion on further detailed analysis of data in this genetic group wherein reciprocal matings were undertaken follows.

Effect of breed of sire

Means and standard errors for the body weights for 4-breed female and male

calves (HTBS) sired by HT and BS bulls from birth to 6 months of age are presented in Table 3. Male calves were comparatively heavier at birth and at subsequent stages of growth than female calves in HTBS group, but the difference was not statistically significant. Since there was no difference due to sex, the data on all calves were pooled together and classified according to the terminal sire breed. No significant difference in body weight was evident in any of the age groups studied.

The results presented herein on body weights and growth rate up to 6 months of age lead to the surmise that some advantage is definitely derived by resorting to 4-breed in comparison to 3-breed crossing in early growth traits. There was also an indication that calves sired by Holstein-Friesian bulls had faster growth rate.

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