

**ESTIMATION OF ADDITIVE AND NON-ADDITIVE EFFECTS  
IN SAHIWAL × FRIESIAN CROSSBREDS**

**Estimation des effets additif et non-additif dans les croisements  
Sahiwal × Frisonne**

**Estimación de los efectos aditivos y no aditivos en el cruce  
Sahiwal × frisona**

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**INTRODUCTION**

In a some what planned crossbreeding experiment in India, an attempt has been made to study the genetic effects among crossbred progeny with regard to certain economic traits measured as the sum of the effects of breed of sire, breeds of dam and non-additive genetic effects associated with fraction of heterozygosity.

**MATERIAL AND METHODS**

The data on age at first calving, first lactation yield and first calving interval on Sahiwal × Holstein crossbreds, maintained at eight military dairy farms, over a period of 30 years (1939-1968) have been used for this study. The breeding policy in operation prior to 1952 was that of criss-crossing. Since 1952-53, a policy of back crossing with Sahiwal bulls was adopted to reduce the exotic inheritance. As a result, grades with 1/64 to 63/64 Holstein inheritance have been produced. Animals with 32/64 and above Holstein inheritance were sired by Holstein bulls and those having less than 32/64 Holstein inheritance were sired by Sahiwal bulls.

The least square means independent from all possible sources of variation were used to calculate the effects due to breed of sire, breed of dam and fraction of heterozygosity expressed in fractions of 1/32 Holstein inheritance, by the multiple regression technique (TOUCHBERRY, 1970).

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RESULTS AND DISCUSSION

Results of analysis of variance indicated that regression sums of squares were highly significant ( $p \leq 0.01$ ) for age at first calving and first lactation yield only.

TABLE 1

THE LEAST SQUARE INTERCEPT  $\alpha$ , AND PARTIAL REGRESSION OF VARIOUS TRAITS ON BREED OF SIRE, BREED OF DAM AND FRACTION OF HETEROZYGOSITY EXPRESSED IN FRACTION OF 1/32

S. No.	Trait	$\alpha$	Regression coefficients				Heterozygosity	
			Breed of sire $b_1$ SE		Breed of dam $b_2$ SE		$b_3$	SE
1.	Age at 1st calving (days) ... ..	1217.9	-2.21 ** $b_1, b_2$ NS	0.33 $b_1, b_3$ **	-1.32 * $b_2, b_3$ NS	0.63	-1.68 *	0.63
2.	First lactation yield (Kg) ... ..	1697.9	11.17 ** $b_1, b_2$ NS	1.68 $b_1, b_3$ *	7.06 * $b_2, b_3$ NS	3.21	3.18 NS	3.21
3.	First calving interval (days) ... ..	439.0	2.20 NS $b_1, b_2$ NS	0.22 $b_1, b_3$ **	0.24 NS $b_2, b_3$ **	0.41	-1.19 **	0.41

\* Significant at 0.05 level of probability.  
 \*\* Significant at 0.01 level of probability.  
 NS Non-significant

Partial regression coefficient for breed of sire ( $b_1$ ), breed of dam ( $b_2$ ) and fraction of heterozygosity ( $b_3$ ) with their standard errors for the three traits are detailed in Table 1. Detailed in Table 2 are the results of regression values evolved for measures of various traits. These values speak about the trend of the trait with the increase in Holstein inheritance in breed of sire/dam and fraction of heterozygosity. Regression values in absolute measures for breed of sire, breed of dam and fraction of heterozygosity for the three traits are shown in Table 3. The values of percent heterosis for halfbreds measured from the partial regression coefficients for the three traits are also detailed in Table 3.

For age at first calving, all the three partial regression coefficients were with a negative sign and were significant, indicating desirable heterosis. The present estimate of heterosis (-4.63) is similar to the results reported by VERLEY and TOUCHBERRY (1961) and PEARSON and McDOWELL (1968).

For first lactation yield, the partial regression coefficients  $b_1$  and  $b_2$  were significant while  $b_3$  was non-significant. The non-significant percent heterosis for halfbreds for first lactation yield was 4.97. DE ALBA and SOLARES (1962) and KATPATAL (1970) reported significant heterosis in respect of milk yield from *Bos taurus* x *Bos indicus* crosses. Significant effect in these reports could perhaps be due to small numbers.

For first calving interval, the partial regression coefficients  $b_1$  and  $b_2$  were not significant while  $b_3$  was significant. The percent heterosis for halfbreds was -8.53, in the desirable direction.

TABLE 2

BREED OF SIRE, BREED OF DAM AND HETEROZYGOSITY OF DIFFERENT GRADES EXPRESSED IN FRACTION OF 1/32 AND REGRESSION VALUES EVOLVED FOR MEASURE OF VARIOUS TRAITS

Breed of cow	Breed of sire	Breed of dam	Fraction of heterozygosity	$\alpha + b_1 s_i + b_2 d_j + b_3 h_k$		
				1	2	3
0 H. ....	0	0	0	1217.90	1697.87	438.97
4 H. ....	0	4	4	1205.90	1738.83	435.17
5 H. ....	0	5	5	1202.90	1749.07	434.23
6 H. ....	0	6	6	1199.90	1751.31	433.28
7 H. ....	0	7	7	1196.90	1769.55	432.33
8 H. ....	0	8	8	1193.90	1779.79	431.38
10 H. ....	0	10	10	1187.90	1800.27	429.49
11 H. ....	0	11	11	1184.90	1810.51	428.54
12 H. ....	0	12	12	1181.90	1820.75	427.59
13 H. ....	0	13	13	1178.90	1830.99	426.64
14 H. ....	0	14	14	1175.90	1841.23	425.59
15 H. ....	0	15	15	1172.90	1851.47	424.75
16 H. ....	0	16	16	1169.90	1861.71	423.80
18 H. ....	0	18	18	1163.90	1882.19	421.90
19 H. ....	0	19	19	1160.90	1892.43	420.95
20 H. ....	0	20	20	1157.90	1902.67	420.01
21 H. ....	0	21	21	1154.90	1912.91	419.06
22 H. ....	0	22	22	1151.90	1923.15	418.11
23 H. ....	0	23	23	1148.90	1933.39	417.16
24 H. ....	0	24	24	1145.90	1943.63	416.21
26 H. ....	0	26	26	1139.90	1964.11	414.32
28 H. ....	0	28	28	1133.90	1984.59	412.42
30 H. ....	0	30	30	1127.90	2005.07	410.53
32 H. ....	32	0	32	1093.42	2157.07	407.25
36 H. ....	32	4	28	1094.86	2172.59	412.97
37 H. ....	32	5	27	1095.22	2176.47	414.40
38 H. ....	32	6	26	1095.58	2180.35	415.83
39 H. ....	32	7	25	1095.94	2184.27	417.26
40 H. ....	32	8	24	1096.30	2188.11	418.69
42 H. ....	32	10	22	1097.02	2195.87	421.55
43 H. ....	32	11	21	1097.38	2199.25	422.98
44 H. ....	32	12	20	1097.74	2203.63	424.41
46 H. ....	32	14	18	1098.46	2211.29	427.27
47 H. ....	32	15	17	1098.82	2215.27	428.70
48 H. ....	32	16	16	1099.18	2219.15	430.13
52 H. ....	32	20	12	1100.62	2234.67	435.85
54 H. ....	32	22	10	1101.64	2242.43	438.71
55 H. ....	32	23	9	1101.70	2246.31	440.14
60 H. ....	32	28	4	1103.50	2265.71	47.29
53 H. ....	32	31	1	1104.58	2277.35	451.58
64 H. ....	32	32	0	1104.94	2281.23	453.01

 $\alpha$  = Is the intercept and is the value for Sahiwal breed.

1 = Age at first calving (days).

2 = First lactation yield (Kg).

3 = First calving interval (days).

TABLE 3  
 HETEROSIS FOR MEASURES OF VARIOUS TRAITS MEASURED IN ABSOLUTE VALUES

S. No.	Trait	$\alpha$	Breed of sire	Breed of dam	Fraction of heterozygosity	Per cent heterosis (halfbreds)
1.	Age at first calving...	1217.9	— 70.72 **	— 42.24 *	— 53.75 *	— 4.63
2.	First lactation yield...	1697.9	7.71 NS	225.92 *	101.76 NS	4.97
3.	First calving interval.	439.0	537.44 **	— 38.05 NS	— 38.05 *	— 8.53

\* Significant at 0.05 level of probability.

\*\* Significant at 0.01 level of probability.

NS Non-significant.

### SUMMARY

Effects of crossbreeding on three important traits in terms of breed of sire, breed of dam and fraction of heterozygosity were studied.

For age at first calving all the three partial coefficients viz. breed of sire ( $b_1$ ), breed of dam ( $b_2$ ) and fraction of heterozygosity ( $b_3$ ) were with a negative sign and were significant. For first lactation yield only  $b_1$  and  $b_2$  were significant while for first calving interval  $b_3$  was significant.

The percentage heterosis in halfbreds for age at first calving, first lactation yield and first calving interval was — 4.63, 4.97 and — 8.53 respectively.

### RESUME

On étudie les effets produits par le croisement sur trois traits importants: la race du père, celle de la mère et la fraction d'hétérozygose.

Quant à l'âge du premier accouchement, les trois coefficients partiels, race du père ( $b_1$ ), race de la mère ( $b_2$ ) et fraction d'hétérozygose ( $b_3$ ), étaient significatifs et de signe négatif. Quant à la première production de lait, ne furent significatifs que  $b_1$  et  $b_2$ , tandis que, pour la première période inter-accouchement, ne le fut que  $b_3$ .

Les pourcentages d'hétérose chez les races pas pures quant à l'âge du premier accouchement, la première production de lait et la première période inter-accouchement, furent, respectivement: — 4,63, 4,97 et — 8,53.

### RESUMEN

Se estudian los efectos producidos por el cruzamiento sobre tres caracteres importantes: raza del semental, raza de la madre y fracción de heterozigosis.

Con relación a la edad al primer parto, los tres coeficientes parciales: raza del semental ( $b_1$ ), raza de la madre ( $b_2$ ) y fracción de heterozigosis ( $b_3$ ), fueron

significativos y de signo negativo. Con relación a la primera producción de leche, sólo fueron significativos  $b_1$  y  $b_2$ , mientras que para el primer período interparto lo fue  $b_3$ .

Los porcentajes de heterosis en razas no puras con respecto a la edad al primer parto, a la primera producción de leche y al primer período interparto fueron, respectivamente, de  $-4,63$ ,  $4,97$  y  $-8,53$ .

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