GENETIC EVALUATION OF HOLSTEIN-SAHIWAL CROSSBRED GRADES: FIRST LACTATION MILK YIELD

La evaluación genética de Holstein x Sahiwal cruzas: La producción de la primera lactancia

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Crossbreeding with improved European dairy breeds has been recognised as the only practical solution for augmenting milk production. Most of the reports on performance of crossbreds indicate that exotic inheritance between 1/2 and 5/8 is most suitable for Indian conditions. A fall in milk production has been noted in higher crosses. The present study has been undertaken to find out the optimum level of Holstein-Sahiwal inheritance for maximum milk production and to investigate the reasons for decline in higher crosses.

The breeding records on 1806 Holstein(H)-Sahiwal(S) crossbreds from 9 military dairy farms in the northern and central India and 1169 crossbreds from 6 farms in southern India were used. The farms in the northern and southern region are situated in locations differing widely in humidity, temperature, altitude and rainfall. However, the feeding and management practices, the policy relating to selection of animals, their breeding and culling was similar at all the farms. The breeding policy, in general, has been of criss-cross breeding which resulted in grades with 1/8 to 7/8 Holstein inheritance. Crossbreds with 1/2 and above Holstein inheritance were Holstein sired and those with less than 1/2 Holstein inheritance were Sahiwal sired.

The data were spread over a period of 7 years beginning 1969. The lactation yield was defined as the milk yield of the cow in 305 days/less. The effects of genetic groups, farms, month and year of calving, parity of dam and age at first calving on first lactation milk yield were studied using least squares procedure. All effects in the model were assumed to be fixed.

The effects due to genetic grades, farms, years, months and age at first calving were significant for first lactation yield in both the regions while that of parity of dam was only significant in the northern region. The significant differences among the genetic groups could be ascribed to differential levels of Holstein inheritance, the merit of cows and bulls and fraction of heterosis, if any, in crossbred grades. The least square means of first lactation yield for crossbred grades

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arranged in ascending order are given below:

Rank	Northern Region		Southern Region	
	Mean(kg)	Genetic groups	Mean(kg)	Genetic groups
1	2286.08	3/8H-5/8S	2065.24	3/8H-5/8S
2	2631.75	3/4H-1/4S	2302.06	3/4H-1/4S
3	2647.29	7/8H-1/8S	2312.82	7/8H-1/8S
4	2653.82	5/8H-3/8S	2378.31	5/8H-3/8S
5	2786.67	1/2H-1/2S	2502.94	1/2H-1/2S

A comparison of performance of different genetic groups revealed that the halfbreds had highest first lactation yield in both the regions. Though the ranking of Holstein-Sahiwal grades was strikingly similar in the two regions, the first lactation milk yield for various grades was higher in the northern region. The higher yield in the northern region was due to the use of better quality sires. Duncan's multiple range test revealed no significant difference among 5/8H,3/4H and 7/8H, while these grades had significantly lower yield than 1/2H in both the regions. The marked superiority of 1/2 Holstein crosses could be due to favourable combination of genes from Sahiwal and Holstein. Though the estimates of heterosis for milk yield were not made, various tropical studies do indicate the importance of non-additive gene action for milk yield. The estimates of heterosis for milk yield in Holstein-Sahiwal crossbreds have been reported to range between 4.9 to 34.0% (Katpatal, 1970; Parmar and Dev,1978; Taneja and Bhat,1978).

The least square means for crossbred grades in both the regions showed an increase upto 50% Holstein inheritance and thereafter a decline was noted. The significant decline in milk production in crossbreds beyond 1/2H level suggested that there was no advantage in going beyond 50% Holstein level. Probably, the tropical environment like ours cannot sustain crossbreds with higher levels of Holstein inheritance not withstanding even the high levels of feeding and management. Evidence from various data on different European-Zebu crosses from tropical countries also suggest that increase in milk production was not linear to the proportionate increase in European inheritance and a decline in higher crosses was noted (Naidu and Desai,1966; Amble and Jain,1967; Khanna and Bhat,1972; Narain and Garg,1979). The decline in milk production in higher Holstein grades has been related to factors like undesirable genetic effects, non-linear interaction between heredity and environment and lack of adaptability to tropical conditions. None of the authors, however, presented any data in support of their arguments.

Apart from the reasons mentioned above, other possible causes for decline in milk yield of higher Holstein grades could be (1) use of inferior sires (2) differential management given to these crossbred grades and (3) inbreeding depression. The examination of data of higher Holstein grades with regard to the above points revealed that the same set of sires were used to produce 1/2H,5/8H,3/4H and 7/8H grades and all these grades were distributed over a number of farms and were contemporaries in production. Hence, the decline in milk production in higher Holstein

Table 1

Expected and observed values of first lactation milk yield

S.No.	Genetic group	Expected yield (kg)		Observed yield	Difference (O-E)	
		Additive	Additive + heterosis		(3-1)	(3-2)
		(1)	(2)	(3)		
			Northern Region			
1.	1/2H-1/2S	2534	2787	2787	253	-
2.	5/8H-3/8S	2718	2781	2654	-64	-127
3.	3/4H-1/4S	2902	3029	2632	-270	-396
4.	7/8H-1/8S	3086	3149	2647	-439	-502
			Southern Region			
1.	1/2H-1/2S	2275	2503	2503	228	-
2.	5/8H-3/8S	2394	2451	2378	-16	-73
3.	3/4H-1/4S	2513	2627	2302	-211	-325
4.	7/8H-1/8S	2632	2867	2313	-319	-376

grades could not be attributed to differential merit of sires or managemental differences. The possibility of inbreeding, as a cause for decline in milk yield though remote was not investigated. However, it may be mentioned that the higher Holstein crosses in the northern and southern region were the progeny of 22 and 15 sires respectively and were born over a period of 7 years (about 2 generations). In the light of the fact that the present study had fairly good number of records in higher Holstein grades for valid comparison, the non-linear interaction between genotype and environment might explain the decline in higher crosses. This aspect was examined by generating the expected values for crossbred grades assuming the gene action for milk yield to be (1) purely additive and (2) considering both additive and heterotic effects.

Assuming that the halfbreds exhibited 10% heterosis, and the interaction between genotype and environment for first lactation milk yield was absent; the expected average first lactation milk yield for halfbreds, assuming an additive gene action, was estimated to be 2534 and 2275 kg in the northern and southern regions, respectively as follows:

$$\text{Percent heterosis} = \frac{F_1 - \bar{M}}{\bar{M}}$$

where, F_1 : is the average performance of 1/2H-1/2S,

$\bar{M}$: is the mid parent value

Average first lactation milk yield of purebred Sahiwal was 1800 kg in the present data. Considering the averages of milk production for purebred Sahiwal and 1/2H-1/2S(expected), the increase in milk yield for each 1/8 increase in Holstein inheritance would be 184 and 119 kg in the northern and southern regions, respectively. The expected average

first lactation milk yield for 5/8H, 3/4H and 7/8H crosses was estimated as:(1) Assuming the gene action for milk yield to be purely additive, and (2) Assuming a heterosis value of 2.5%, 5.0% and 2.5% for 5/8H, 3/4H and 7/8H grades respectively (Touchberry, 1970).

The expected and observed values for various crossbred grades are given in Table 1. The differences between the observed and expected values could be attributed to genotype x environment interactions. It may be noted that differences increased with the increase in proportion of Holstein inheritance in both the regions, suggesting that genotype x environment interaction was more marked as the fraction of Holstein inheritance increased beyond 5/8H level. These results do suggest that genotype x environment interactions could be the limiting factors for milk production in higher crosses.

SUMMARY (1) (3)

The effect of different levels of Holstein-Sahiwal inheritance on first lactation milk production was examined. A total of 1806 Holstein-Sahiwal crossbreds from 9 farms in northern and 1169 crossbreds from 5 farms in southern India were considered. The effects of genetic grades, farms, years, months and age at first calving on first lactation yield were significant in both the regions, while that of parity of dam was significant only in the northern region. The half-breds had the highest first lactation yield in both the regions. The means for crossbreds in the two regions showed an increase upto 50% Holstein inheritance and thereafter a decline was noted. The reasons for decline in milk production in higher crosses have been discussed.

ZUSAMMENFASSUNG (2) (3)

Der Einfluß der verschiedenen Ebenen von Holstein-Sahiwal-Vererbung über Milchleistung der ersten Laktation wurde untersucht. Für diese Untersuchung wurden insgesamt 1806 Holstein-Sahiwal-artgekreuzten Kühe von 9 Höfen von Norden und 1169 Artgekreuzten von 5 Höfen von Süden dieses Landes berücksichtigt. Der Einfluß von genetischen Sorten, Höfen, Jahren, Monaten und Lebensalter bei Erstabkalbung über erste Laktationsleistung war in beiden Gegenden bedeutsam, wohingegen war der von Gebärfähigkeit des Mütterchens nur in der nördlichen Gegend von Bedeutung. Die Halbartgekreuzten hatten in beiden Gegenden höchste Milchleistung in der ersten Laktation. Die Durchschnittswerte der Artgekreuzten in beiden Gegenden zeigten eine Zunahme bis 50% Holstein-Vererbung und danach war eine Abnahme spürbar. Die Gründe für Abnahme an Milcherzeugung in höheren Artgekreuzten hat man besprochen.

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