

EFFECT OF INBREEDING ON SOME PERFORMANCE TRAITS IN SAHIWAL CATTLE

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ABSTRACT

Pedigree, breeding and performance records of a purebred Sahiwal herd maintained at Livestock Experiment Station, Jahangirabad, Khanewal during the period 1939-97 were utilised for the present study. The effect of inbreeding on various performance traits was studied using a fixed effect model with inbreeding and other effects, viz. year and season of birth as independent variables. The two sets of analyses were carried out, one with cows classified as either inbred ($F>0$) or non-inbred ($F=0$), and other with inbreeding coefficients as a covariate to estimate change in performance per unit (%) increase in inbreeding coefficient. The analyses were carried out by least squares technique. The pedigree analysis revealed that there was a decreasing trend in the average level of inbreeding in the present herd. The coefficient of inbreeding among the 503 inbred animals was 3.25 percent, the highest level being 26.78 percent. The number of sires used was 213 out of which 27 were inbred with average inbreeding coefficient 3.125 percent. Only 2 sires were having coefficient of inbreeding 25 percent or more. One of the main reasons for this low level of inbreeding in the herd was incompleteness of pedigrees especially for animals born in the earlier years of period under study. Although, there was a slight inbreeding depression in most of the traits but effect of inbreeding on all the performance traits was non-significant statistically more precise pedigree recording and planned mating strategies be adopted to avoid adverse inbreeding effects. It is signified that in future.

Key Words: Inbreeding depression, Pedigree, Sahiwal

INTRODUCTION

Inbreeding is a mating system and is the consequence of mating closely related individuals. The genetic effect of inbreeding is the increased homozygosity which result in fixing several traits. This uncovers several recessive lethals and reduces overall vigour, viability and performance. Inbreeding being an important tool, in addition to selection, has been used for the improvement of farm animals for centuries. However, there had been more prejudice against inbreeding even during the time of Robert Bakewell (1725-1795); even many people thought it almost sacrilegious (Lush, 1963). The past experience has shown that inbreeding has usually been associated with the appearance of genetic defects and a general overall decline in vigour and performance. Few studies have been made on inbreeding in Sahiwal cattle in Pakistan (Aslam and Ahmad, 1969; Ahmad *et al.*, 1974; Dahlin *et al.*, 1995.) indicating that inbreeding has to a certain extent been going on for many years. The inbreeding coefficient is affected by the amount of pedigree information (Falconer and Mackay, 1997) and the earlier estimates based on few generations may underestimate inbreeding. As the present herd has been

maintained as a pure-bred herd since its inception, inbreeding might has been practised intentionally or unintentionally. Hence, the present study report the results of the extent of inbreeding in the herd and its influence on various performance traits.

MATERIALS AND METHODS

Pedigree, breeding and performance records of a purebred Sahiwal herd maintained at Livestock Experiment Station, Jahangirabad, Khanewal during the period 1939-97 were utilised for the present study.

Identification number of cows with records were used to trace their pedigree back to the base population. The later consisted of all animals before or at the establishment of the livestock farm. The resulting pedigree data consisted of both male and female sides of pedigree and date of birth of each animal. The coefficient of inbreeding of each animal was calculated using DFREML set of computer programme (Meyer, 1991). Annual trend in inbreeding was estimated by averaging inbreeding coefficients of animals within each year. The effect of inbreeding on various productive (first lactation milk yield, first lactation length, first dry period) reproductive (age at first

calving, calving interval, service period, number of services per conception) and lifetime (lifetime milk yield, productive life, herd life, longevity) traits were studied using a fixed effect model with inbreeding and other effects viz, year and season of birth as independent variables. The two sets of analyses were carried out, one with cows classified as either inbred ($F>0$) or non-inbred ($F=0$), and other with inbreeding coefficients as a covariate to estimate change in performance per unit (%) increase in inbreeding coefficient. For these analyses LSMLMW computer programme (Harvey, 1990) was used.

RESULTS AND DISCUSSION

Pedigrees of the animals were traced back to the base population of Sahiwal cow to calculate the level of inbreeding in these animals. Analysis of pedigree records of 2745 animals having identification for the extent of inbreeding revealed that 503 animals (18.31 percent) were inbred with an average inbreeding of 3.125 percent and the highest level being 26.78 percent. Out of the total of 213 sires used 27 were found inbred having average inbreeding coefficient of 3.125 percent with the highest value being 26.125 percent. Most frequent value for this category of animals was zero. The level of inbreeding in inbred population reported in other study on cattle in Pakistan revealed that the coefficient of in breeding in 325 inbred cows averaged 6.91 ± 0.32 percent with a range on 0.15 to 33.3 percent (Ahmad *et al.*, 1974). One of the main reasons for low level of inbreeding in the present herd was incomplete pedigrees especially for animals born in earlier years. About 25 percent of the animals (658) did not have sire identification while number of animals for which both sire and dam identification was missing and were 367. The distribution of animals with respect and to level of inbreeding has been presented in Table 1.

Table 1: Distribution of animals with respect to level of inbreeding

Level of inbreeding (percent)	No. Of animals
>25.00	3
12.500 to 25.000	55
06.250 to 12.500	41
03.125 to 06.250	65
00.100 to 03.125	147
<0.000 to 00.100	192
Non-inbred	2242

The trend of inbreeding during 58 years' span has been presented in Fig. 1. The dependent variable was

the inbreeding coefficient while year of birth was the only fixed effect along with the error term. Except for the base animals, where inbreeding was zero due to non-availability of pedigree information, there was a continuous upward trend in average inbreeding level up to mid sixties in the herd.

The least squares means for different productive, reproductive and lifetime traits in inbred and non-inbred groups are presented in Table 2.

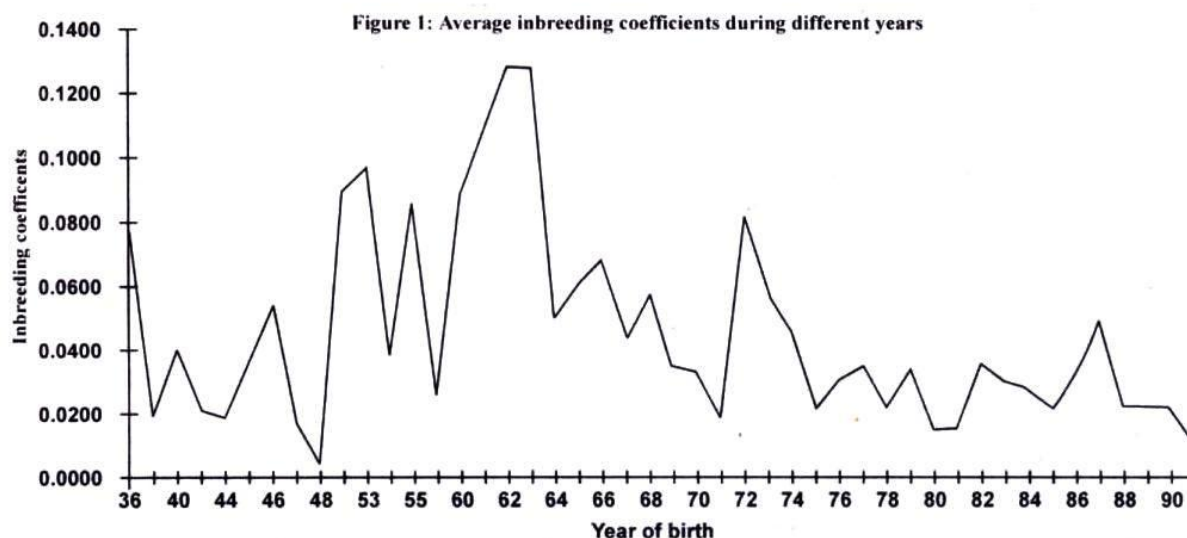
Table 2: Least Squares means for Various Productive, reproductive and Lifetime traits in inbred and non-inbred cows.

Traits	Inbred group	Non-inbred group
First lactation milk yield (kg)	1254.388 \pm 33.806 (372)	1331.373 \pm 29.605 (1331)
First lactation length (days)	221.264 \pm 8.548 (372)	253.613 \pm 4.818 (1331)
First dry period (days)	230.387 \pm 13.951 (386)	227.482 \pm 9.37 (1362)
Age at first calving (days)	1372.507 \pm 19.605 (414)	1370.951 \pm 12.009 (1438)
calving interval (days)	437.533 \pm 13.711 (372)	468.717 \pm 7.923 (1331)
Service period (days)	156.202 \pm 12.501 (386)	229.994 \pm 22.923 (1362)
No. of services per conception	1.304 \pm 0.092 (385)	1.387 \pm 0.045 (1362)
Lifetime milk yield (kg)	8118.828 \pm 390.164 (414)	9442.852 \pm 301.659 (1438)
Productive life (days)	1153.156 \pm 50.201 (414)	1329.773 \pm 30.954 (1438)
Herd life (days)	2479.637 \pm 123.005 (296)	2378.890 \pm 69.789 (1251)
Longevity (days)	3780.923 \pm 117.778 (414)	3733.061 \pm 69.094 (1251)

Figures in the parenthesis indicate number of observations.

There was a decline in first lactation milk yield and first lactation length in inbred cows than non-inbreds. Similar results were reported by Ahmad *et al.* (1974) for Sahiwal cow. A slight increase in dry period and age at first calving was also observed in inbred group. Although not expected theoretically, a decrease in calving interval, service period and number of services per conception was noted in inbred group of cows which is a desirable change. Ahmad *et al.* (1974) also reported that calving interval was slightly depressed by inbreeding in Sahiwal herd maintained at Livestock Experiment Station, Allahdad district Multan during the period 1926-1966. A decline in lifetime milk yield and productive life was noticed whereas herd life and longevity were increased in inbred group of cows as compared to non-inbred group.

Linear and quadratic effects of inbreeding on various productive, reproductive and lifetime traits are presented in Table 3. It is evident that level of inbreeding did not affect any of these traits significantly. The linear effect of inbreeding on first lactation milk yield was negative whereas the quadratic effect was positive but none of the effect on first



effect was positive but none of the effect on first lactation milk yield reached a significant level ($P < 0.05$). The inbreeding depression was 0.093 kg. Similar findings have been reported by Reddy and Nagarcenkar (1990) and Nandagawali *et al.* (1996) for Indian Sahiwal cow. Whereas Ahmad *et al.* (1974) reported a higher level of average inbreeding coefficient (6.91 %) and adverse effects of inbreeding

Sympath (1989) who reported that inbreeding had no effect on lactation length in Indian Sahiwal cattle. However, some other workers reported that inbreeding had a significant effect on lactation length in Sahiwal cattle (Srimvas and Gurnani, 1981; Reddy and Nagarcenkar, 1990).

There was no effect of inbreeding on first dry period as obtained in the present study. The regression

Table 3: Linear and Quadratic Effects of Inbreeding on Various Performance Traits

Traits	Linear effect	Quadratic effect
First lactation milk yield (kg)	-0.093±0.074	0.00003±0.000056
First lactation length (days)	0.0124±0.0189	-0.00001±0.00001
First dry period (days)	-0.0196±0.0343	0.00005±0.00003
Age at first calving (days)	0.0361±0.0436	-0.00003±0.00003
Calving interval (days)	-0.0056±0.0303	0.00028±0.00002
Service period (days)	-0.0028±0.0309	0.00004±0.00002
Services per conception (No.)	-0.00002±0.00002	0.00000±0.00000
Lifetime milk yield (kg)	0.756±0.869	-0.0009±0.0006
Productive life (days)	0.0751±0.1120	-0.00009±0.00008
Herd life (days)	0.0452±0.2790	-0.00007±0.00020
Longevity (days)	0.040±0.2691	-0.00004±0.00019

on milk yield in Pakistani Sahiwal cow. However, Rege and Wakhungu (1992) reported a lower inbreeding coefficient and 138.8 kg more milk in inbred group of Sahiwal cows as compared to non-inbred group. But these studies did not describe the number of generations considered or the completeness of pedigree information. So a valid comparison is not possible.

The regression of lactation length on inbreeding was 0.0124±0.0189 days per one percent increase in inbreeding (Table 3). The inbreeding depression was not high enough to cause significant change in lactation length with average inbreeding. These findings were substantiated by the results obtained by Reddy and

coefficient of dry period on inbreeding was -0.0196±0.043 days which was non-significant (Table 3). These findings were not in line with the results reported by Galal *et al.* (1977) and Reddy and Nagarcenkar (1990), who reported a significant effect of inbreeding on dry period.

The linear and quadratic regression of calving interval, service period and number of services per conception on inbreeding coefficient was not different from zero. These findings were substantiated by the findings of Ahmad *et al.* (1974) and Dias *et al.* (1994) who reported that inbreeding had no effect on reproductive traits in different breeds of dairy cattle.

However, the findings of the present investigation were not in line with the results of other workers Reddy and Nagarcenkar, 1990; Rege and Wakhungu, 1992) who reported that inbreeding had a significant effect on these traits.

The linear regression of age at first calving on inbreeding coefficient was 0.036 days. It meant that although there was a slight increase in age at first calving with each percent increase in inbreeding but it was statistically non-significant. These findings were in agreement with those of Ahmad *et al.* (1974) and reddy and Nagarcenkar (1990) who reported that inbreeding had no effect on age at first calving in Sahiwal cattle. However, Rege and Wakhungu (1992) reported that inbred cows had 45.4 days later age at first calving in Kenyan Sahiwals.

It was concluded from the present study that more precise pedigree recording and planned mating strategies be adopted to avoid adverse inbreeding effects in future.

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