

# Performance Evaluation of Karan Fries and Karan Swiss Cattle under Closed Breeding System

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**ABSTRACT :** The 490 and 380 performance records of Karan Fries and Karan Swiss cows developed through crossbreeding followed by inter-se mating were evaluated for production, reproduction performance and disposal rate. Duration of study (1982-92) was grouped into five periods (1982-83; 1984-85; 1986-87; 1988-89; 1990-92) and each year was divided into four seasons (Winter: Dec.-Jan.; Spring: Feb.-March; Summer: April-June; Rainy: July-Sept.; Autumn: Oct.-Nov). Data were also classified according to sire and level of inbreeding. The least squares means of FLY (first lactation yield -305 days), FLL (first lactation length), FSP (first service period), FDP (first dry period), FCI (first calving interval), MY/FLL (milk yield per day of first lactation length), MY/FCI (milk yield per day of first calving interval), EBV (expected breeding value) and EBE (expected breeding efficiency) were 3,173±82 kg, 346±11 days, 143±11 days, 75±6 days, 423±11 days, 10.6±0.2 kg, 8.9±0.2 kg, 3,380±26 kg, and 88.2±1.3% respectively in Karan Fries. Corresponding estimates in Karan Swiss cows were 2,616±82 kg, 328±8 days, 148±12 days, 103±9 days, 435±13 days, 8.9±0.2 kg, 7.2±0.3 kg, 2,924±38 kg and 86.0±3.8% respectively. The effect of sire was significant on FLY, MY/FLL, MY/FCI and EBV in both the herd ( $p<0.01$ ). The 10 and 15% sires showed superiority (FLY) over herd average of 11 and 7% in Karan Fries and 32 and 21% in Karan Swiss cattle respectively. Inbreeding has adversely and significantly ( $p<0.05$ ) affected the FLY, MY/FLL, MY/FCI and survivability of Karan Fries females; FDP and disposal through culling of Karan Swiss heifers. The Karan Fries heifers with inbreeding above 12.5% performed 16% lower FLY to herd average. The effect of season of calving was significant on FLL, FSP and FCI ( $p<0.05$ ) in Karan Fries. Summer calvers (361±12) were have higher lactation length and autumn calvers (329±14) had minimum. Period of calving significantly influenced the FSP, FCI, MY/FLL and MY/FCI in Karan Fries and FLY, MY/FLL and MY/FCI in Karan Swiss. Production efficiency traits in Karan Fries herd witnessed higher yield in the last two periods whereas, Karan Swiss heifers showed fluctuating performance. The findings suggested judicious use of available genetic variability, keeping of inbreeding under safer level and managerial interventions for the consistent improvement of both herds. (*Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 1 : 1-6*)

**Key Words :** Sire, Inbreeding, Performance, Karan Fries, Karan Swiss

## INTRODUCTION

The dairy farmers in the country demands high yielding animals, which may cater to their requirements to improve the overall productivity of the animals. Crossbreeding with elite sires made dairy farming commercially viable in many parts of the country. It is, therefore, necessary to have a nucleus herd of high genetic merit to meet the requirement of cross bred bulls. In a closed herd with limited number of sires, there is likelihood of increase in inbreeding level after 6-7 generations and subsequent ill effect on performance of the animals are expected. These herd have shown fluctuation in terms of survivability, production and reproduction performance during last few years. Inbreeding along with certain other factors have been named for this situation. Effect of inbreeding have been extensively studied in purebreds (Gurnani et al., 1971; Reddy and Nagarcanar, 1988 in Zebu cattle and; Milgior et al., 1992, and Thompson et al., 2000 in exotic). However, meager information is available on strains/breed developed through crossbreeding and inter-se mating. Therefore, it would be

useful to investigate the production performance in various inbreeding groups and effect of genetic and non-genetic factors on production and reproduction traits, so that appropriate breeding programmes can be made for bringing about genetic improvement in these herd.

## MATERIALS AND METHODS

Present study was carried out in the Karan Fries (KF) and Karan Swiss (KS) strains of cattle developed at National Dairy Research Institute (NDRI), Karnal. Development of KS commence in 1963 with the prime objective to evolve strain/breed of crossbred cattle of exotic inheritance suited to Indian tropical climatic conditions. Sahiwal (S) and few Red Sindhi (RS) cows were used as Zebu and Brown Swiss (B) as an exotic. The American Brown Swiss was selected because of its high fat content and high milk production. The color also matched with that of Sahiwal and Red Sindhi. Frozen semen of nine proven bulls with average breeding value of 5,400 kg per lactation was imported. The following type of crossbreds were obtained: F1, F2, 3/4 BS×1/4 Zebu and halfbreds. There was no significant effect of heterosis found in various genetic groups of crossbreds with respect to production.

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Therefore, in April 1980 the breeding committee of institute merged all genetic groups and practices selective breeding for genetic improvement. The level of exotic inheritance was desired to be kept at 1/2 to 5/8, but selection of animals was done essentially on the basis of their expected breeding value (EBV). The females were selected on the basis of their own performance and males were selected on the basis of their pedigree. Presently Karan Swiss cows are expected to have 50% level of exotic inheritance (Gurnani et al., 1986a).

The development of Karan Fries (KF) started in 1971, by using Tharparkar (T) as a Zebu and three exotic breeds, namely, Holstein Friesian (H), Brown Swiss (B) and Jersey (J). The main objective of this project was to determine the appropriate choice of exotic breed and optimum level of exotic germ plasm. The halfbreds were further mated to Holstein to obtain crossbreds with 75% exotic inheritance consisting of two breed crosses (3/4 H×1/4 T) and 3-breed crosses (1/2 H×1/4 B×1/4 T and 1/2 H×1/4 J×1/4 T). No significant improvement was shown by 3-breed crosses over the F 1 (H×T) crosses. The comparative performance of 75% HS with 50% HS crossbreds also did not show any significant advantage of having 75% exotic level. Therefore, best possible genetic improvement could be obtained by exploiting of additive genetic variance. The breeding committee of the Institute in 1982, thus, merged all crossbreds with above 50% HF inheritance and further improvement to be brought about by selective breeding. The new strain was named as 'Karan Fries'. Presently level of Holstein inheritance is 62.5% (Gurnani et al., 1986b). This institute has embarked upon a programme of proper selection of Karan Fries males on the basis of their pedigree, own performance half sibs, fitness, and freezing quality of semen. Semen of these bulls is being distributed to the different regions of the country to evaluate their performance on the basis of their daughters performance.

Data was recorded on 1349 Karan Fries and 992 Karan Swiss females born during the period from 1980 to 1991. Out of these performance records of 490 Karan Fries cows, sired by 32 bulls and 383 Karan Swiss cows sired by 28 bulls calved during the period from 1982 to 1992 were evaluated. Pedigree chart was prepared for every animal and the pedigree of each animal was traced back upto foundation stock assuming their inbreeding coefficient (F) zero. The F of every animal was estimated by path coefficient method (Wright, 1922). Data were classified into 5 periods of 2 years each except the VI period (3 years due to comparatively small number of observations) to minimize the management and climatic fluctuations. The year was sub divided into 5 seasons i.e. winter (Dec- Jan), spring (Feb-Mar), summer (Apr-June), rainy (July-Sept) and autumn (Oct-Nov) based on relative humidity and

ambient temperature. The animals were grouped into 4 levels of inbreeding, based on their F i.e. non-inbred (Fx: 0), lowly inbred (Fx: ≤6%), marginally inbred (Fx: >6≤12%) and highly inbred (Fx: >12%). The effect of various factors on the first lactation performance traits was investigated by least squares analysis of variance (Harvey, 1975), which included sire, inbreeding, period and seasons as fixed effect and AFC as a co variable as below

$$X_{ijklm} = \mu + I_i + S_j + P_k + S_l + b_{XA} (A_{ijklm} - \bar{A}) + e_{ijklm}$$

Where,  $X_{ijklm}$  is performance of  $m^{\text{th}}$  cow,  $i^{\text{th}}$  inbreeding group,  $j^{\text{th}}$  sire,  $k^{\text{th}}$  period of calving and  $l^{\text{th}}$  season of calving.  $\mu$  is population mean,  $I_i$  is effect of level of inbreeding,  $S_j$  is effect of sire,  $P_k$  is period of calving,  $S_l$  is season of calving,  $b_{XA}$  regression of  $X_{ijklm}$  on AFC ( $A_{ijklm}$ ),  $\bar{A}$  is average age of first calving, and  $e_{ijklm}$  is residual random error with 0 mean and variance  $\sigma^2$  (NID) (0,  $\sigma^2$ ). For estimating EBV and EBE the AFC was not included in the model and pooled data for all available records (minimum 2 complete lactation records) were used. Breeding Efficiency was estimated as per Wilcox et al. (1957) and EBV as

$$EBV = \frac{2n_i h^2}{4 + (n_i - 1)h^2} (X_{D_i} - \mu)$$

Where,  $n_i$  = Number of daughters of  $i^{\text{th}}$  sire,  $h^2$  = heritability of FLY,  $X_{D_i}$  = Average FLY of  $n_i$  daughters of  $i^{\text{th}}$  sire,  $\mu$  = herd average,  $X_D$  = Average FLY of  $n_i$  daughters of  $i^{\text{th}}$  sire.

The differences among sub class means were tested by DMRT (Kramer, 1957). The heritability ( $h^2$ ) was estimated on adjusted data by paternal half sib correlation method (Becker, 1986). The abnormal and incomplete records resulted from chronic or incurable diseases were excluded from the study. The sires having a minimum of five progeny were included in study. The traits investigated were first lactation yield -305 days (FLY), first lactation length (FLL), first service period (FSP), first dry period (FDP), first calving interval (FCI), milk yield per day of first lactation length (MY/FLL), milk yield per day of first calving interval (MY/FCI), expected breeding value (EBV) and expected breeding efficiency (EBE). Nutrition requirements were met through a balanced ration of green, dry fodder and concentrates. Feeding schedules are laid down according to age groups considering the requirements for maintenance, growth, production, pregnancy etc. For adult heifers and cows, green fodder and other roughages were provided *ad libitum*. All the animals are exclusively stall fed in open paddocks and recording of milk started from fifth day of calving.

**Table 1.** Least-squares analysis of variance of performance traits in Karan Fries cattle

Traits	Source of variation											
	Sire		Inbreeding		Season		Period		Regression		Error	
	DF	MS	DF	MS	DF	MS	DF	MS	DF	MS	DF	MS
FLY(kg)	31	1,005,439**	3	20,173,280*	4	125,822	4	733,461	1	1,958,204	449	1,249,556
FLL (kg)	31	8,804.2	3	3,309	4	17,350*	4	7,076	1	19,235	449	6,832.3
FSP (kg)	31	7,419.8	3	1,359	4	18,523*	4	14,598*	1	12,587	373	1,931.4
FDP (days)	31	2,766.3	3	807	4	1,111.3	4	3,922	1	1,166.5	373	6,923.0
FCI (days)	31	7,531.2	3	1,148	4	18,525*	4	15,904*	1	19,431.2	373	4.2
MY/FLL(kg)	31	10.7**	3	11.8*	4	6.2	4	11.5*	1	7.1	449	3.7
MY/FCI(kg)	31	6.3**	3	15.7*	4	2.3	4	10.0**	1	0.0	373	180,063.5
EBV (kg)	31	494,826.3**	3	415,439.0	4	71,441.2	4	10,309	1	-	449	175.67
EBE (%)	31	275.0	3	24.22	4	134.50	4	348.23	1	-	373	533.413

\* Significant ( $p < 0.05$ ); \*\* significant ( $p < 0.01$ ).

FLY-first lactation yield 305-days or less; FLL-first lactation length; FSP-first service period; FDP-first dry period; FCI-first calving interval; MY/FLL-milk yield per day of first lactation length; MY/FCI-milk yield per day of first calving interval; EBV-expected breeding value; EBE-expected breeding efficiency.

**Table 2.** Least-squares analysis of variance of performance traits in Karan Swiss cattle

Traits	Source of variation											
	Sire		Inbreeding		Season		Period		Regression		Error	
	DF	MS	DF	MS	DF	MS	DF	MS	DF	MS	DF	MS
FLY (kg)	27	123,392**	3	630,497	4	108,375	4	1,724,774*	1	221,851	343	557,658
FLL (days)	27	6,609	3	988	4	9,372	4	18,791*	1	5,003	343	6,321
FSP (days)	27	5,865	3	5,133	4	17,657	4	15,231	1	5,867	266	8,043
FDP (days)	27	4,665	3	15,707*	4	2,635	4	2,303	1	10,127	266	4,025
FCI (days)	27	5,201	3	7,822	4	13,609	4	17,397	1	197	266	8,699
MY/FLL (kg)	27	10.78**	3	6.41	4	0.88	4	26.06**	1	10.60	343	4.56
MY/FCI (kg)	27	2.09**	3	4.83	4	2.95	4	16.08**	1	2.62	266	4.26
EBV (kg)	27	205,388*	3	92,804	4	132,309	4	446,228**	1	-	343	120,530
EBE (%)	27	230.91	3	362.30	4	934.00	4	352.00	1	-	266	318.13

\* Significant ( $p < 0.05$ ); \*\* significant ( $p < 0.01$ ).

FLY-first lactation yield 305-days or less; FLL-first lactation length; FSP-first service period; FDP-first dry period; FCI-first calving interval; MY/FLL-milk yield per day of first lactation length; MY/FCI-milk yield per day of first calving interval; EBV-expected breeding value; EBE-expected breeding efficiency.

## RESULTS AND DISCUSSION

The least squares means with coefficient of variation for different traits are presented in Table 3 for Karan Fries and in Table 4 for Karan Swiss respectively. The least squares means of FLY, FLL, FSP, FDP, FCI, MY/FLL, MY/FCI, EBV and EBE were  $3.173 \pm 82$  kg,  $346 \pm 11$  days,  $143 \pm 11$  days,  $75 \pm 6$  days,  $423 \pm 11$  days,  $10.6 \pm 0.2$  kg,  $8.9 \pm 0.2$  kg,  $3.380 \pm 26$  kg and  $88.2 \pm 1.3\%$  respectively in Karan Fries. Corresponding estimates in Karan Swiss cows were  $2.616 \pm 82$  kg,  $328 \pm 9$  days,  $148 \pm 12$  days,  $103 \pm 9$  days,  $435 \pm 13$  days,  $8.9 \pm 0.2$  kg,  $7.2 \pm 0.3$  kg,  $2.924 \pm 38$  kg and  $86.0 \pm 3.8\%$  respectively. The present estimates in Karan Fries were higher than estimates reported by Jadhav et al. (1991), Dutt et al. (1998) and Singh et al. (2000), however, similar to Karan Swiss cattle.

### Effect of sire

Least squares analysis revealed significant ( $p < 0.01$ , Table 1 and 2) effect of sire on FLY, MY/FLL, MY/FCI and

EBV in both herds. The sires showing 10 and 15% superiority for FLY and EBV over herd average were 11 and 7% in Karan Fries, and 32 and 21; and 12 and 7% respectively in Karan Swiss cattle. The rank correlation of FLY with EBV for sires was  $>0.82$  in both the herds indicating that ranking of sire on the basis of either traits could be equally effective. Results were in agreement with those reported by Kumar (1992). The effect of sire was non-significant on FLL, FSP, FDP, FCI and EBE in both the herds indicating that these traits were more under the influence of management and other environmental factors than the genetic factors.

### Effect of inbreeding on performance traits

The percentage of inbreds, their average inbreeding coefficient, average annual increase of inbreeding coefficient were 20.9, 6.65 and 1.10% in Karan Fries and 36.2, 5.53 and 1.96% in Karan Swiss herd respectively. The FLY, MY/FLL and MY/FCI ( $p < 0.05$ , Table 1) in Karan Fries and FDP ( $p < 0.05$ , Table 2) in Karan Swiss were

**Table 3.** Least-squares means of performance traits in Karan Fries cattle

	FLY (kg)	FLL (days)	FSP (days)	FDP (days)	FCI (days)	MY:FLL (kg)	MY:FCI (kg)	EBV (kg)	EBE (%)
Mean	3,173±82 (490) 26	346±11 (490) 26	143±11 (415) 62	75±6 (415) 64	423±11 (415) 21	10.6±0.2 (490) 23	8.9±0.2 (415) 28	3.380±26 (490) 15	88.2±1.3 (307) 7
<b>Inbreeding</b>									
1	3,332±70 <sup>a</sup> (412)	347±9 (412)	133±9 (244)	72±5 (350)	423±9 (350)	11.1±0.2 <sup>a</sup> (412)	9.5±0.2 <sup>a</sup> (350)	3.417±17 (412)	89.2±1.2 (244)
2	3,264±136 <sup>ab</sup> (36)	359±16 (36)	145±18 (36)	72±9 (30)	413±17 (30)	10.7±0.4 <sup>a</sup> (36)	8.9±0.4 <sup>a</sup> (30)	3.448±45 (36)	88.8±3.1 (36)
3	3,206±168 <sup>ab</sup> (21)	329±21 (21)	157±26 (14)	72±11 (19)	423±21 (19)	11.1±0.5 <sup>ab</sup> (21)	9.4±0.5 <sup>ab</sup> (19)	3.355±54 (21)	89.1±3.4 (14)
4	3,791±108 <sup>c</sup> (21)	348±22 (21)	157±27 (13)	85±12 (16)	432±29 (16)	9.7±0.5 <sup>b</sup> (21)	7.8±0.5 <sup>b</sup> (16)	3.301±54 (21)	85.4±3.9 (13)
<b>Seasons</b>									
1	3,185±108 (101)	329±14 <sup>a</sup> (101)	137±14 <sup>a</sup> (48)	73±7 (89)	416±14 <sup>a</sup> (89)	11.1±0.3 (101)	9.1±0.3 (89)	2.954±58 (58)	87.6±2.5 (48)
2	3,167±97 (139)	357±12 <sup>b</sup> (139)	153±13 <sup>b</sup> (99)	76±6 (119)	426±12 <sup>b</sup> (119)	10.5±0.3 (139)	8.7±0.3 (119)	2.894±44 (128)	88.4±2.2 (99)
3	3,189±97 (142)	361±12 <sup>b</sup> (142)	168±12 <sup>b</sup> (117)	81±6 (117)	448±13 <sup>b</sup> (117)	10.6±0.3 (142)	8.9±0.3 (117)	2.858±48 (107)	87.5±2.4 (86)
4	3,100±119 (65)	338±15 <sup>ab</sup> (65)	138±15 <sup>a</sup> (46)	71±8 (55)	415±16 <sup>a</sup> (55)	10.4±0.4 (65)	8.7±0.4 (55)	2.954±60 (57)	91.6±2.4 (46)
6	3,225±133 (43)	343±16 <sup>ab</sup> (43)	126±17 <sup>a</sup> (28)	76±9 (36)	409±17 <sup>a</sup> (36)	10.6±0.4 (43)	9.1±0.4 (36)	2.959±72 (33)	90.8±2.9 (28)
<b>Periods</b>									
1	3,017±305 (29)	355±36 (29)	143±38 <sup>a</sup> (25)	91±20 (25)	431±38 <sup>a</sup> (25)	9.1±0.8 <sup>a</sup> (29)	7.5±0.8 <sup>a</sup> (25)	3.352±88 (29)	91.5±5.6 (23)
2	2,990±175 (148)	316±21 (148)	199±21 <sup>b</sup> (17)	65±11 (17)	384±21 <sup>b</sup> (117)	9.7±0.5 <sup>b</sup> (148)	8.3±0.5 <sup>b</sup> (117)	3.367±53 (148)	94.4±3.3 (96)
3	3,283±118 (113)	356±14 (113)	157±15 <sup>b</sup> (103)	85±8 (103)	441±5 <sup>b</sup> (103)	10.4±0.3 <sup>b</sup> (113)	8.4±0.3 <sup>b</sup> (103)	3.364±36 (113)	86.8±2.3 (78)
4	3,267±139 (119)	360±17 (119)	168±17 <sup>b</sup> (105)	86±9 (105)	451±7 <sup>b</sup> (105)	10.3±0.4 <sup>b</sup> (119)	8.5±0.4 <sup>b</sup> (105)	3.443±51 (119)	84.4±2.7 (58)
5	3,278±173 (81)	352±20 (81)	128±22 <sup>a</sup> (65)	60±11 (65)	404±22 <sup>a</sup> (65)	11.4±0.5 <sup>b</sup> (81)	9.8±0.5 <sup>b</sup> (65)	3.443±52 (81)	89.0±3.5 (42)

Means with different subscript are significantly different. Values in parenthesis are number of observation. Values in italics are coefficient of variation.

significantly and adversely affected by inbreeding. A consistent decreased performance of FLY, MY/FLL and MY/FCI were recorded with the increased level of inbreeding in both the herds (Table 3 and 4). However, inbreeding (F) <12% did not adversely affects the milk performance traits. The highly inbred Karan Fries cows (F >12%) showed 16% lower performance than herd average of FLY. Non-significant effect of inbreeding on EBV, indicated that inbreeding had more effect on first lactation traits than later lactations. Adverse effect of high level of inbreeding on milk production traits was also reported by Miglior et al. (1992) Thompson et al. (2000) in exotic cattle, and Gurnani et al. (1971), Khanna et al. (1979), Srinivas and Gurnani (1981) and Singh and Nagarcenkar (1997) in Zebu cattle. Significantly higher FDP for marginally (112±9) and highly (142±19) inbred heifers indicated that F beyond 6% accelerate the dry period in Karan Swiss herd. Effect of inbreeding was non significant on other performance traits, however heifers above 12% F showed poor production and reproduction performance. Extensive use of some sires and the close relationship among sires in these herds were mainly accounted for built-up of inbreeding. Inbreeding might also had offset genetic gains due to losses in survivability. Nevertheless, it may also affect the accuracy of selection. Result suggested that bulls of high level of inbreeding should be avoided unless the genetic potential of mating is more.

#### Effect of inbreeding on disposal rate

Percentage of females born during 1980 to 1991 and disposed off through culling and mortality up to age at first calving (AFC) in different inbreeding groups were shown in

Table 5. Maximum culling and mortality in Karan Fries females were recorded in highly inbreds however, effect of inbreeding was significant (p<0.05) on culling only. Whereas in Karan Swiss, effect of inbreeding was significant (p<0.05) on mortality only. Higher culling and mortality above 6% F were indicating that animals in above categories might be have lesser tolerance to cope with environmental stress and were prone to health disorders and poor growth. Present results were in concurrence with Srinivas and Gurnani (1981).

#### Effect of season of calving

Season of calving showed nonsignificant effect on all performance traits in Karan Swiss cattle (Table 2), which was in concurrence with the findings of Narang et al. (2001). However, season of calving significantly influenced the FLL, FSP and FCI (p<0.05) in Karan Fries (Table 1). Maximum lactation length was observed for summer (361±12) and lowest for winter calvers (329±14), which was also significantly different from other season (Table 3). Longer lactation period of spring and summer calvers could be due to higher FSP of such cows. The lowest FSP and FCI was recorded for autumn calvers. The FSP and FCI for summer calvers were highest and also significantly differed from other seasons (Table 3). The longer service period for summer could be due to high environmental stress. The longest calving period for summer calvers might be due to longest service period of such cows. Significant effect of season indicated that performance of Karan Fries cattle might be affected by differential availability of fodder and climatic fluctuations unlike Karan Swiss cattle. Similar results in Frieswal cattle were reported by Jadhav et al. (1991).

**Table 4.** Least-squares means of performance traits in Karan Swiss cattle

	FLY (kg)	FLL (days)	FSP (days)	FDP (days)	FCI (days)	MY/FLL (kg)	MY/FCI (kg)	EBV (kg)	EBE (%)
	2.616±82 (383) 29	328±9 (383) 25	148±12 (307) 66	103±9 (306) 72	435±13 (306) 22	8.9±0.2 (383) 25	7.2±0.3 (306) 28	2.924±38 (383) 91	86.0±3.8 (306) 18
<b>Inbreeding</b>									
1	2.731±63 (289)	328±7 (289)	133±9 (244)	84±6* (289)	419±9 (244)	9.3±0.2 (289)	7.6±0.2 (244)	2.979±29 (289)	90.2±1.6 (244)
2	2.736±117 (56)	330±12 (56)	145±18 (36)	75±3* (56)	425±19 (36)	9.4±0.3 (56)	7.5±0.4 (36)	2.940±54 (56)	88.5±6.7 (36)
3	2.485±177 (22)	336±19 (22)	157±26 (14)	112±9** (22)	433±28 (14)	8.4±0.5 (22)	7.0±0.6 (14)	2.899±82 (22)	92.3±8.5 (14)
4	2.493±193 (17)	318±20 (17)	157±27 (13)	142±19** (17)	465±28 (13)	8.7±0.5 (17)	6.5±0.6 (13)	2.877±89 (17)	80.2±9.6 (13)
<b>Seasons</b>									
1	2.593±124 (58)	323±13 (58)	153±17 (48)	114±12 (58)	443±18 (48)	9.0±0.3 (58)	7.1±0.4 (48)	2.954±58 (58)	87.4±5.0 (48)
2	2.581±95 (128)	338±10 (128)	153±13 (99)	100±9 (128)	436±14 (99)	8.8±0.3 (128)	6.8±0.3 (99)	2.894±44 (128)	84.3±4.5 (99)
3	2.628±103 (107)	341±11 (107)	171±15 (86)	109±10 (107)	458±15 (86)	8.8±0.3 (107)	7.3±0.3 (86)	2.858±48 (107)	84.5±4.3 (86)
4	2.577±129 (57)	312±14 (57)	118±18 (46)	99±13 (57)	413±19 (46)	8.9±0.3 (57)	7.3±0.4 (46)	2.954±60 (57)	92.6±4.0 (46)
5	2.700±153 (33)	327±16 (33)	146±21 (28)	94±15 (33)	427±22 (28)	9.1±0.4 (33)	7.3±0.4 (28)	2.959±72 (33)	90.5±4.7 (28)
<b>Periods</b>									
1	2.303±319* (35)	357±34** (35)	217±43 (33)	140±30 (35)	507±45 (33)	8.9±0.9** (35)	6.6±0.9* (33)	2.747±148* (35)	76.0±5.6 (33)
2	3.004±228* (117)	299±240** (117)	150±33 (96)	119±23 (117)	442±34 (96)	11.1±0.6* (117)	8.6±0.7** (96)	3.107±106* (117)	83.5±4.5 (96)
3	2.654±161** (102)	305±17** (102)	125±23 (78)	112±16 (102)	412±24 (78)	9.5±0.4** (102)	7.9±0.5** (78)	2.876±75** (102)	93.8±5.7 (78)
4	2.478±235* (74)	319±25* (74)	109±36 (58)	74±26 (74)	391±38 (58)	7.4±0.6** (74)	6.1±0.8* (58)	2.920±109** (74)	92.8±4.4 (58)
5	2.639±281* (55)	360±29* (55)	138±42 (42)	71±29 (55)	416±44 (42)	7.6±0.8** (55)	6.6±0.9* (42)	2.970±130** (55)	92.1±4.3 (42)

Mean with different subscript are significantly different. Values in parenthesis are number of observation. Values in italics are coefficient of variation.

**Table 5.** Effect of inbreeding on culling and mortality rate in Karan Fries and Karan Swiss cattle

Inbreeding groups	Karan Fries			Karan Swiss		
	Exposed (No)	Died (%)	Culled (%)*	Exposed (No)	Died (%)*	Culled (%)
1	1,062	12	22	645	12	25
2	145	16	16	206	15	26
3	60	17	25	84	22	32
4	80	17	39	57	22	30
Overall	1,349	13	26	992	14	26

Significant (p<0.05).

### Effect of period of calving

Periods of calving were significantly influenced the FSP, FCI, MY/FLL and MY/FCI (p<0.05) in Karan Fries cattle (Table 2). The least square means for FSP and FCI varied from 99±21 and 384±21 days respectively for period 2 to 168±17 and 451±7 days respectively for period 4 (Table 3), and no consistent trend of both traits was observed over the periods. This fluctuation in FSP could be due to changes in environmental conditions over periods. The variability in FCI over periods might be due to its high association with FSP, since similar trend was observed for service period. These findings were in agreement with the results of Chaudhary et al. (1995). The least square means for both milk production efficiency traits varied from 9.1±0.1 and 7.5±0.8 kg (period 1) to 11.4±0.5 and 9.9±0.5 kg (period 5). This consistent increase in MY/FLL and MY/FCI might be due to use of some proven sires. Results were in concurrence with the reports of Arora et al. (1993) and Singh et al. (2000). Whereas in Karan Swiss herd significantly fluctuating trend was obtained for FLY, FLY/LL and FLY/FCI (Table 4), which might be attributed to differential availability of fodder, managerial practices and also due to use of different set of sires. Moreover, sires used for a period were mostly selected on

the basis of dam's milk yield which can not be taken as their actual genetic worth. Singh and Gurnani (2003) attributed higher involuntary culling also for fluctuating performance at this farm.

### Age at first calving

The influence of first calving was non-significant on all first lactation productions and reproduction traits. The results were in agreement with the findings of Kumar (1992) and Singh (1992)

### Heritability estimates

The  $h^2$  estimates of FLY, MY/FLL, MY/FCI and EBV were 0.41±0.13, 0.51±0.15, 0.41±0.14 and 0.57±0.18 respectively. The corresponding estimates in Karan Swiss cattle were 0.49±0.17, 0.42±0.16, 0.44±0.19 and 0.32±0.15 respectively. The results indicated that these traits are more influenced by additive genetic variability and judicious sire selection is expected to respond favorably. However,  $h^2$  estimates of FLL, FSP, FDP and FCI were low and associated with high standard error (ranged from 0.00 to 0.11) indicating that selection had little scope and could be improved by intervening managerial and other environmental factors. Estimates for production traits were

at higher side than reported by Raheja (1994) in crossbreds.

It is inferred from the above findings that there is large variation in transmitting ability of sires for production traits. High level of inbreeding have adversely affecting the performance and survivability traits, therefore attempt should be made to keep inbreeding under safer limit. Fluctuating trends in performance traits was due to both genetic and environmental factors hence require intervention both at genetic and managerial level.

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