

PERFORMANCE OF CROSSBRED DAIRY CATTLE AT MILITARY DAIRY FARMS IN PAKISTAN

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ABSTRACT

Crossbreeding has been considered as a quick way of increasing performance of low productive tropical breeds. Crossbreeding of indigenous cattle with exotic such as Holstein is underway in Pakistan for the last four decades. Data on first lactation milk yield of crossbred dairy cattle (n=2025) from three Military dairy herds for 1985-2006 were used for this study to evaluate performance of crossbred dairy cattle. The exotic cattle represented mainly Holstein while Jersey, Ayrshire and Red Dane were also used sporadically. The local cattle were generally Sahiwal. The total first lactation milk yield for crossbreds averaged 1633±47.0 kg. The highest total milk yield was found for Neelum Military dairy farm (2328±62.3 kg) and lowest for Lahore Military dairy farm (1356±50.1 kg). These values had almost 1000 kg range. The first lactation length in this study averaged 240±5.5 days. Cows had longest lactation length at Neelum Military farm (264±6.8 days) while cows at Lahore Military farm (229±5.5 days) had the shorter lactations. First lactation performance of different genetic groups showed higher total milk yield for 50% exotic inheritance (1749±33.3 kg) as compared to all other genetic groups. The lowest total milk yield was found for 25% exotic inheritance (1567±171.3 kg). The season of calving had non-significant effect on milk yield and lactation length while year of calving affected both traits significantly. Phenotypic trends revealed that first lactation milk yield and lactation length increased @ 27.7 kg/year and 0.45 days/year respectively, from 1985 to 2005. Managemental and feeding differences at various farms accounted for most of the variation in first lactation milk yield. The performance of these crossbreds as compared to buffaloes with average first lactation milk yield of 1800 kg or those of Sahiwal purebreds (1430 kg) challenges the sustainability of the system especially when demands of these crossbreds are higher to cope with disease and environmental stresses.

Key words: Dairy cattle, Crossbreeding, Milk yield, Lactation length, Phenotypic trend.

INTRODUCTION

Dairy production is a function of many factors contributing its overall efficiency which commonly include genetic, environmental and managemental components. Pakistan dairy sector mainly consist of buffaloes and crossbred dairy cattle contributing major share in dairy produce. Dairy cattle crossbreds in Pakistan have been generally produced as a result of crossing of highly improved *Bos taurus* breeds with local less productive *Bos indicus* breeds to increase milk production in the region. Crossbreds resulting from this sort of experiments performed invariably depending upon the use of exotic breeds, environmental factors and breeding strategy used.

In Pakistan major crossbreeding activity started on Military dairy farms around 1970. Semen from exotic breeds like Holstein, Jersey, Red Dane and Ayrshire were used for crossing with local cattle primarily Sahiwal, Red Sindhi, Tharparker and Haryana. But most frequent crosses were of Holstein and Jersey with Sahiwal mainly because both Holstein and Jersey crossbreds performed better as compared to other crosses. Successive crossbreeding of exotic breeds with local cattle has

produced several generations of crossbreds on military dairy farms.

Estimation of genetic and phenotypic parameters for productive and reproductive traits is an important tool for the definition and evaluation of selection programs. Results from various studies analysed that research should be intensified to identify and utilize animals with greater genetic potential. The performance traits like milk yield is considerably affected by environmental factors, which, in addition to genetic differences, are responsible for the marked variation between breeds, herds and animals within the same breed. It is therefore fundamentally important to identify factors that affect crossbred cow productivity so that breeding programs may be planned and implemented properly in order to obtain a balance between genetics and environment. Major environmental factors that affect performance and evaluation of individual animals and populations are herd, year and calving season, age at calving and management (Payn and Wilson, 1999, Msanga *et al.* 2000, Epaphras *et al.*, 2004).

Similarly various animal factors also have been reported to affect milk production as investigated earlier like breed, age, stage of lactation, parity and even milking

frequency (Albuquerque *et al.* 1999, Tekerli *et al.* 2000; Johnson *et al.* 2002)

Dairy cattle crossbreds present on military dairy farms have never been evaluated for genetic and environmental factors affecting their performance. Present study was planned to document genetic and environmental variation in first lactation performance traits of crossbred dairy cattle maintained at three military dairy farms in Punjab province of Pakistan.

MATERIALS AND METHODS

Source of Data: The first lactation records of crossbred animals maintained at three Military dairy farms viz; Military Dairy Farm, Lahore (MF Lahore), Bolan Military Dairy Farm (MF Bolan), Okara and Neelum Military Dairy Farm (MF Neelum), Okara from 1984 to 2006 were collected for this study. Records of each animal were on two separate cards named as cow pedigree sheet and cow history sheet. Records from these sheets were computerized. The records of any cow consisted of following information: animal ID, sire, dam, date of birth, date of service, date of calving, 305-day milk yield, total lactation milk yield, date of drying and date of disposal etc. The performance traits examined were 305-day milk yield, total milk yield, lactation length, dry period, calving interval, service period and age at first calving.

Total of 2025 records from the three military farms were collected initially spread over the last 22 years (from 1984-2006) therefore became available for analysis. Incomplete lactations for any recorded reason or lactations with abortion or other abnormality were not utilized for study.

Data Analysis: Traits were analyzed under a fixed effect model having main effects of genetic group, herd, year and season of birth/calving. Pedigrees were used to calculate level of *Bos taurus* inheritance and animals were grouped into the following seven genetic groups; 1, 25% taurus inheritance; 2, 25-49% taurus inheritance; 3, 50% taurus inheritance 4, 51-62.5% taurus inheritance; 5, 63-74% taurus inheritance; 6, 75% taurus inheritance, 7, unknown. Four seasons were defined as winter (December to February), spring (March to May), summer (June to August) and autumn (September to November). Two and three way interactions were fitted in the preliminary analysis but removed afterwards because the interactions were not significant for most of the traits. Fixed effect model analysis was performed using Statistical Package for Social Scientist (SPSS, 2004).

RESULTS AND DISCUSSION

Productive Performance

305-d milk yield: The first lactation productive performance of crossbred dairy cattle present at three military dairy farms is given in Table 1. The average 305-d milk yield for crossbreds was 1613±49.03 kg. This economically important trait varied widely among three herds of military dairy farms. The highest 305-d milk yield was found for Neelum Military dairy farm, Okara (2257±64.9 kg), and lowest for Lahore Military dairy farm (1348±52.3 kg).

First lactation performance of different genetic groups showed higher 305-d milk yield for 50% exotic inheritance (1712±34.7 kg) as compared to all other genetic groups. The lowest 305-d milk yield was found for 25% exotic inheritance. The cows calving during different years showed a wide variation in first lactation 305-d milk yield. Phenotypic trend was 37.6 kg/year from 1984 to 2006. The maximum first lactation 305-d milk yield was found for cows calving in summer as compared to other seasons while minimum yield was found for cows calving in autumn.

The performance of crossbreds at three different military farms showed wide variations that may be due to differences in managemental and feeding practices used at these farms. Highest 305-d milk yield at MF Neelum is contributed by raising of selected cows as this farm has a embryo transfer facility aimed to produce more number of offspring from elite cows. That's why production of cows maintained at this farm is much higher as compared to other two farms where policy for raising crossbred cows is different. The first lactation average 305-d milk yield at MF Lahore and MF Bolan is slightly lower as compared to reports from military farms in India (Rao and Nagarckenkar (1979); Deshpande and Bond (1982); Deshpande and Bond (1983a, b); Bhadauria and Katpatal (2003). No report on performance of crossbred dairy cattle on military dairy farms in Pakistan is available earlier.

In this study 305-d milk yield was higher for crossbreds with 50% exotic inheritance as compared to other genetic groups as reported earlier (Rao and Nagarckenkar (1979); Deshpande and Bond (1982); Deshpande and Bond (1983a, b); Bhadauria and Katpatal (2003). The first lactation 305-d milk yield of different genetic groups present at these three herds was not significantly different.

The herd and year of calving significantly affected first lactation 305-d milk yield in crossbred cattle at military farms which is in agreement with earlier studies (Bhat *et al.* (1978); Dangi (1979); Deshpande and Bond (1982). Season of calving has no significant effect on 305-d milk yield in this study as reported by some other studies (Bhadauria and Katpatal (2003).

The first lactation 305-d milk yield increased with passage of time from 1984 to 2006 with a rate of 37.6 kg per year (Figure 1). This positive trend may be due to use of better management and feeding practices used. The main aim of raising crossbred cows at military dairy farms is to provide sustainable supply of milk and milk products to army troops and their families so every effort for increasing milk is used.

Total Milk yield: The total first lactation milk yield for crossbreds averaged 1633±47 kg (Table 1). The highest total milk yield was found for Military farm (MF) Neelum, Okara (2328±62.3 kg), and lowest for Lahore Military dairy farm (1356±50.1 kg).

First lactation performance of different genetic groups showed higher total milk yield for 50% exotic inheritance (1749±33.3 kg) as compared to all other genetic groups. The lowest total milk yield was found for 25% exotic inheritance (1567±171.3). The cows calving during different years showed a wide variation in first lactation total milk yield (Figure 2). Phenotypic trend positive as total milk yield increased @ 27.6 kg/year from 1984 to 2006. The maximum first lactation total milk yield was found for cows calving in summer as compared to other seasons while minimum yield was found for cows calving in autumn.

The performance of crossbreds at three different military farms showed wide variations that may be due to differences in managemental practices used at these farms. Highest total milk yield was found at MF Neelum just like 305-d milk yield. The first lactation average total milk yield at MF Lahore and MF Bolan is bit lower as compared to reported earlier for military farms in India (Rao and Nagarckenkar (1979); Deshpande and Bond (1982); Deshpande and Bond (1983a, b); Bhadauria and Katpatal (2003).

In this study total milk yield was higher for crossbreds with 50% exotic inheritance as compared to other genetic groups as reported earlier (Rao and Nagarckenkar (1979); Deshpande and Bond (1982); Deshpande and Bond (1983a, b); Bhadauria and Katpatal (2003). The first lactation total milk yield of different genetic groups present at these three herds was significantly different. The total milk yield for genetic groups from 50 % to 75% was not much different from each other which may be due to the fact that decrease in milk yield related to above 50 or 62.5% is countered by availability of higher inputs and better management practices used at military dairy farms. Military dairy farms has good infra structure for raising dairy animals along with better resources for feeding of animals including huge fodder growing area and commercial cattle feed mill to ensure sustainable and balanced fodder/feed supply to animals.

Taneja *et al.* (1979) also observed that there was no linear increase in production level above 50% with the

increase in the level of inheritance of the exotic parent and it cannot be assumed that grading up to a total replacement of genes will lead to higher levels of production, at least in cattle.

The herd and year of calving significantly affected first lactation total milk yield in crossbred cattle at military farms which is in agreement with earlier studies (Bhat *et al.* (1978); Dangi (1979); Deshpande and Bond (1982); Nagarckenkar and Rao (1982). Season of calving has no significant effect on total milk yield in this study as reported by some other studies (Chaudhary and Shafiq (1995); Bhadauria and Katpatal (2003).

The first lactation total milk yield increased with passage of time from 1984 to 2006 with a rate of 27.6 kg per year just like 305-d milk yield (Fig 3.8). This increase in milk production over years may not only be caused by inter-annual random climatic changes but also encompass favorable management changes. Given the non-significant effect of calving season on milk production performance in the present study, it could be inferred that an improved management in the herds might have caused improvement in the milk production traits. This result agrees well with other studies (Million and Tadelles (2003); Demeke *et al.* (2004); Haile *et al.* (2009).

Lactation Length: The first lactation length averaged 240±5.5 days (Table 1). Cows at had longest lactation length at MF Neelum (264±6.8 days) while cows at (229±5.5 days) had the shorter lactations as compared to MF Bolan (242±5.6). Phenotypic trend in first lactation length was positive. Lactation length increased @ 1.7 days per year over last 22 years (Figure 3). Spring calvers had higher lactation length than the cows calving in other seasons. Present findings of lactation length in crossbred cows are similar to Talbot (1994) while Dhara *et al.* (2006) and Rao and Nagarckenkar (1979) reported higher lactation length (351±12.0 and 306.58±2.67 days respectively) for crossbred cows.

Lactation length in different genetic groups varied significantly. Similar to 305-d milk yield and total milk yield, lactation length in genetic groups from 50 to 75% exotic inheritance was not much different. Year of calving also has significant effect on lactation length as reported by Dangi (1979) and Shafiq (1987). While season of calving had a non-significant effect on lactation length in this study. Non-significant effects of season of calving on lactation length were also observed by Narain and Garg (1979); Bhat *et al.* (1980); Nagarckenkar and Rao (1982); Rao *et al.* (1984); Akhtar (1992); Dalal *et al.* (1993), Sreemannarayana and Rao (1995) and Ahmed *et al.* (2007).

Dry Period: The average first dry period in crossbred cows at military dairy farms was 318±21.4 days (Table 1). The longest dry period was observed in Military farm Neelum (335±28.4 days) followed by MF Lahore (330±22.5 days) while shortest observed in MF Bolan as

292±23.7 days.. First dry period varied among seasons and years of calving.

The dry period values in all herds were too long as compared to ideal dry period values in dairy cattle and phenotypic trend also showed ever increasing trend at the rate of 2.30 days per years (Figure, 4).

The first dry period was longer in cows calving in winter (335±23.8 days) while shortest was on observed for those calving in autumn (290±25.5 days). The first dry period was not significantly different in various genetic groups of crossbred cows, however, longest dry period was observed in genetic group having 25% exotic inheritance, while lowest was found in 63 to 74% exotic inheritance group. Although there was not much different in values of first dry period in genetic groups having exotic inheritance from 50 to 75 %.

The season and year of calving showed a significant effect on first dry period which is also reported earlier (Talbot *et al.* (1994); Ahmad (1999); Chenyambuga and Mseleko (2009).

Reproductive Performance: The results of reproductive traits analysed in this study are as follows.

Service Period: The first service period in this study averaged 272±17.1 days (Table 2). It was minimum in MF Bolan (259±19.1) while maximum in MF Neelum (301±23.3). The first service period varied in different seasons and years of calving. The genetic group did not have significant effect on first service period. Heifers calving in autumn have shorter service period (247±20.5 days) as compared to heifers calving in spring (309±19.9 days). The first service period increased @ 5.3 days per year with the passage of time in different years of calving (Figure 5).

The season of calving had a significant effect on first service period. This may be due to the fact that cows calving in spring face hotter months immediately after calving and oestrous may be suppressed due to higher temperature in summer. Contrarily, cows calving in autumn face cooler months of winter after calving so rebreed earlier due to comfortable season. The increase in length of service period also accounts for longer calving intervals ultimately leading to poor reproductive efficiency. Both heat stress and nutritional status of dams at mating were important factors influencing length of service period.

The higher values for first service in crossbred dairy cattle observed in this study are in agreement with early reports (Chaudhry and Shah, 1989). The longer service period does have negative influences on the milk yield and it needs to be shorten to decrease the calving interval which is a requisite for efficient milk production (Talbot, 1994).

Calving Interval: The first calving interval averaged 543±17.9 days in this study. The first calving interval

was different among herds as longest calving interval was found in MF Neelum (567±24.4 days) while shortest was found in MF Bolan (525±19.9 days). The calving interval varied among seasons and years of calving significantly. The phenotypic trend for first calving interval was positive and increasing at the rate of 2.60 days per year (Figure 6).

The genetic group has no significant effect on first calving interval in this study. The herd, season and year of calving had a significant effect of first calving interval as reported in earlier studies (Deshpande and Bonde (1983); Pyne and Dattagupta (1994).

Longer calving interval with increasing trend over the year results in poor economic efficiency from animal production. This situation would lead to worse if the current scenario continues for longer time. Improvement in feeding and reproductive management might be helpful to rectify this deterioration.

Age at First Calving (AFC): The age at first calving for crossbred cows in this study averaged 1300±5.5 days (Table 2). The age at first calving was highest in MF Bolan (1423±6.2 days) followed by MF Lahore (1280±6 days) while lowest was found in MF Neelum (1156±7.6 days). The age at first calving was lower in crossbreds having 50% exotic inheritance (1241±4.1 days) followed by cows having 51-62.5 % exotic genes.

Crossbred cows born in spring, has lower age at first calving (1189±6.6 days) while higher was found in cows born in Autumn (1557±6.9 days). Phenotypic trend for age at first calving (Figure, 7) was negative as AFC decreased @ 26.7 days per year.

The average AFC in present study for crossbred cattle (1300 days or 42.6 months), was in agreement with earlier reports of AFC as 40.1 months observed for crossbred dairy heifers in smallholder dairy farms in Malawi (Agyemang and Nkhonjera 1990), and 40.6 months for crossbred dairy heifers in different dairy production systems in central highlands of Ethiopia (Shiferaw *et al.*, 2003) and 40.2 months in crossbreds of Boran with Friesian and Jersey (Demeke *et al.*, 2004). In some reports even higher AFC values like 58.3 months reported for smallholder crossbred dairy heifers in Zimbabwe (Masama *et al.*, 2003).

The lower age at first calving was observed for crossbred cows having 50% exotic genes (1241±4.1 days), followed by 51-62.5% exotic inheritance (1280±3.2 days) while higher AFC values were found in cows with 63-74 % exotic genes (1311±2.6 days).

The increase in age at first calving with increasing proportion of exotic genes in crossbred cows is in agreement with earlier studies (Agyemang and Nkhonjera, 1990; Yifat, 2009). These studies reported that heifers with above 50 % exotic inheritance had higher AFC than heifers with 50% exotic inheritance. Higher AFC in cows with higher exotic blood may be due

to the inadequacy in maintaining higher nutrient requirement of high grade crossbred heifers as their body size increases. Many studies also reported lower AFC estimates for crossbreds of Sahiwal with Ayrshire and Friesian cows as 1020 days (Thorpe *et al.*, 1993), 999 days (Thorpe *et al.*, 1994) ; 781 days in Holstein X Sahiwal, 755 days in Jersey X Sahiwal crossbreds (Chaudhry *et al.* 1993) and 1092 days in Friesian X Sahiwal crossbreds (Rafique *et al.*, 2001).

In present study no significant difference was observed among different genetic groups for age at first

calving. This insignificant effect of breed on AFC in this study is in agreement with the report of Agyemang and Nkhonjera (1990).

A number of previous studies revealed that managemental factors especially nutrition determines pre-pubertal growth rates and reproductive development (Negussie *et al.*, 1998; Masama *et al.*, 2003). The better-managed and well-fed heifers grew faster, served earlier and resulted in more economic benefit in terms of sales of pregnant heifers and/or more milk and calves produced during the lifetime of the animal.

Table 1 Least squares means for first lactation productive traits in crossbred dairy cattle at Military farms

Genetic Group (% Exotic)	305-Day Milk Yield		Total Milk Yield		Lactation Length	Dry Period	
	N	Mean ± SE	N	Mean ± SE	Mean ± SE	N	Mean ± SE
25%	7	1567±171.3	8	1631±154.6	272±16.9	4	371±84
26-49%	3	1593±241.2	3	1566±235.5	163±25.8	3	362±97.6
50%	180	1712±34.7	184	1749±33.3	259±3.7	149	300±15.2
51-62.5%	416	1601±26	428	1629±25.2	254±2.8	339	309±11.4
63-74%	952	1653±20.3	975	1680±19.6	257±2.1	844	294±8.6
75%	164	1671±36.2	165	1694±35.2	257±3.9	134	309±16.2
Unknown	9	1502±147	9	1490±143	225±15.7	8	285±62.8
Season of Calving							
Winter	598	1617±54.4	606	1645±51.9	238±5.7	492	335±23.8
Spring	465	1615±56.2	482	1636±54.5	249±6	395	342±24.6
Summer	340	1677±59.2	350	1682±57	241±6.3	295	307±26
Autumn	328	1552±59.6	334	1577±57	235±6.2	299	290±25.5
Herds							
MF Lahore	809	1348±52.3	829	1356±50.1	229±5.5	710	330±22.5
MF Bolan	766	1560±53.3	783	1563±51.4	242±5.6	642	292±23.7
MF Neelum	156	2257±64.9	160	2328±62.3	264±6.8	129	335±28.4
Overall Mean	1731	1613±49.03	1772	1633±47.0	240±5.5	1481	318±21.4

Table 2 Least squares means for first lactation reproductive traits in crossbred dairy cattle at Military farms

Genetic Group (% Exotic)	CI		SP		GP		AFC	
	N	Mean ±SE	N	Mean ±SE	N	Mean ±SE	N	Mean ±SE
25%	5	642±64.4	5	382±61.7	13	275±1.3	14	1279±15.1
26-49%	3	522±83.9	3	258±80.2	4	275±2.3	4	1336±27.1
50%	142	533±13.4	140	253±12.9	216	274±0.4	221	1241±4.1
51-62.5%	326	534±9.9	314	250±9.6	495	274±0.3	502	1280±3.2
63-74%	799	526±7.5	794	256±7.3	1025	274±0.2	1046	1311±2.6
75%	126	536±14.3	125	257±13.8	188	274±0.4	194	1279±4.4
Unknown	8	510±53.9	8	250±52	9	272±1.6	9	1191±19.1
Season of Calving								
Winter	464	553±20.4	457	281±19.5	690	274±0.5	706	1202±6.3
Spring	372	578±20.7	366	309±19.9	542	274±0.6	552	1189±6.6
Summer	282	523±22	278	250±21.1	375	274±0.6	381	1245±7
Autumn	291	517±21.4	288	247±20.5	343	274±0.6	351	1557±6.9
Herds								
MF Lahore	663	546±18.9	653	269±18.1	890	274±0.5	904	1280±6
MF Bolan	624	525±19.9	614	259±19.1	898	274±0.6	919	1423±6.2
MF Neelum	122	567±24.4	122	301±23.3	162	274±0.6	167	1156±7.6
Overall Mean	1409	543±17.9	1389	272±17.1	1990	274±0.4	1990	1300±5.5

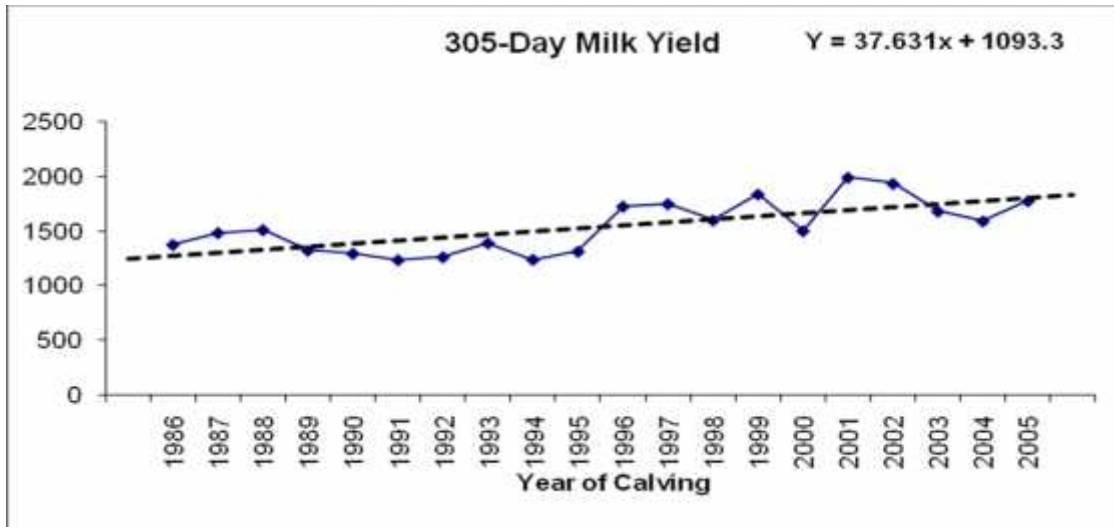


Figure 1. Phenotypic trend of first 305-d milk yield in different years of calving

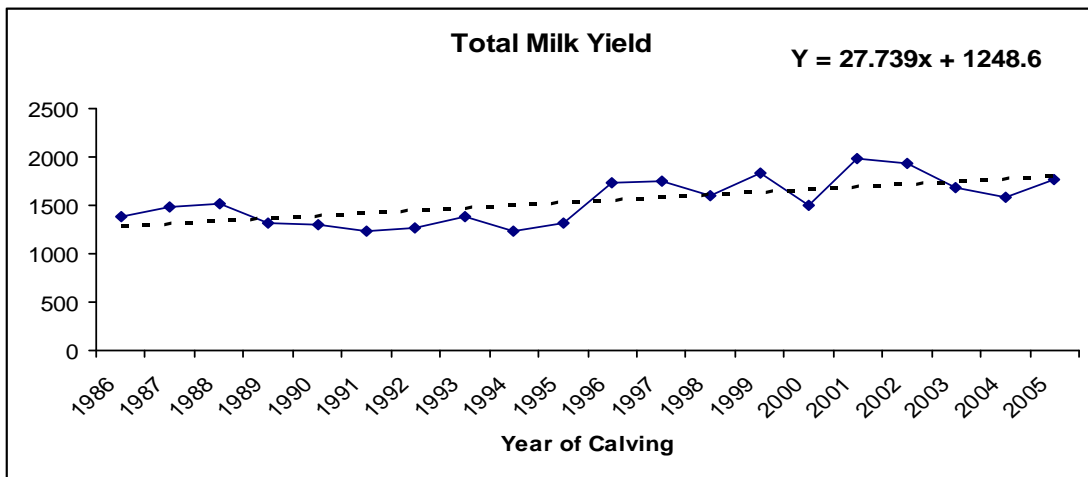


Figure 2. Phenotypic trend of First lactation total milk yield in different years of calving

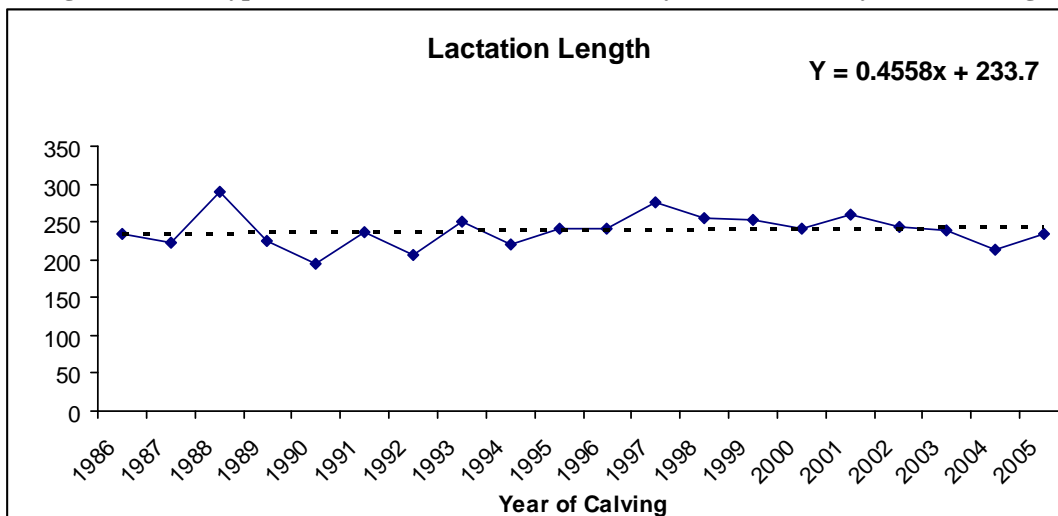


Figure 3 Phenotypic trend of first lactation length in different years of calving

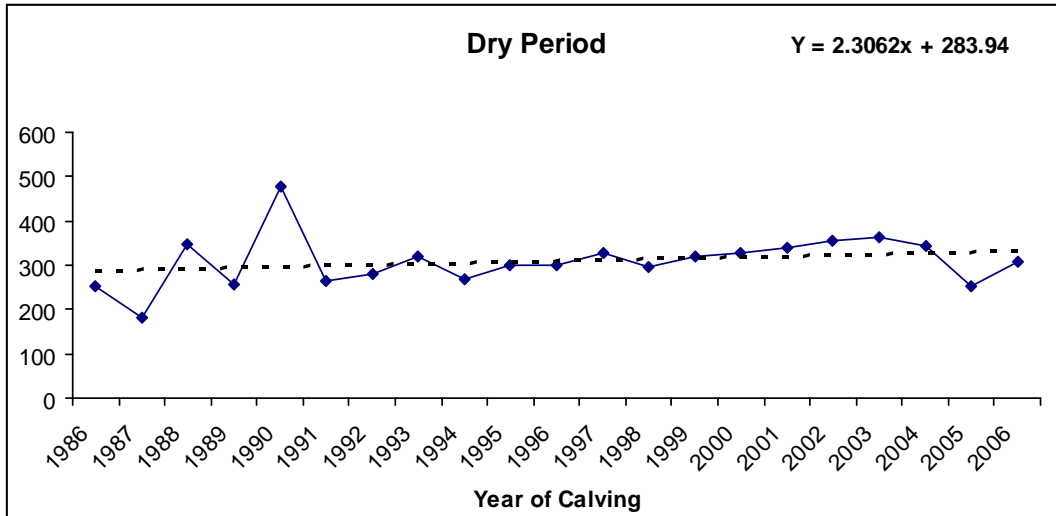


Figure 4. Phenotypic trend of first dry period in different years of calving

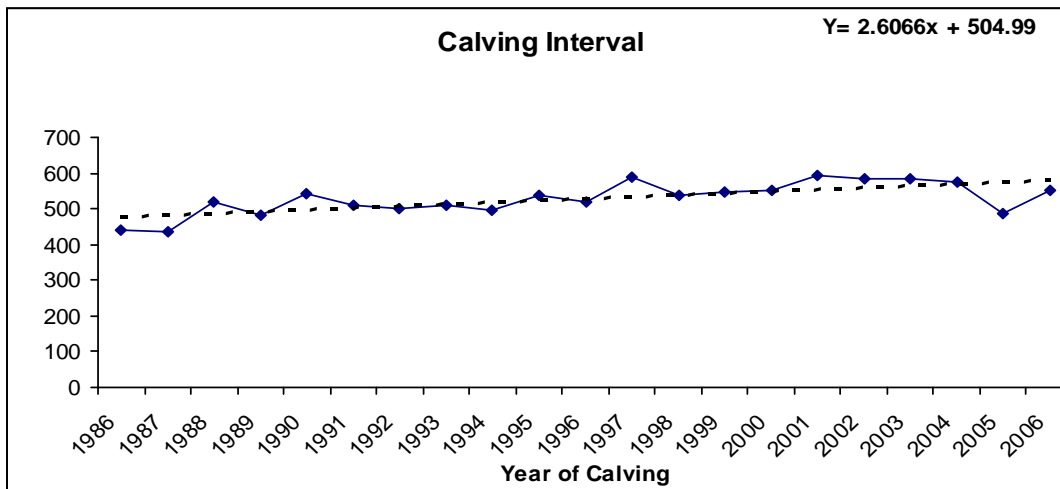


Figure 5. Phenotypic trend of first calving interval in different years of calving

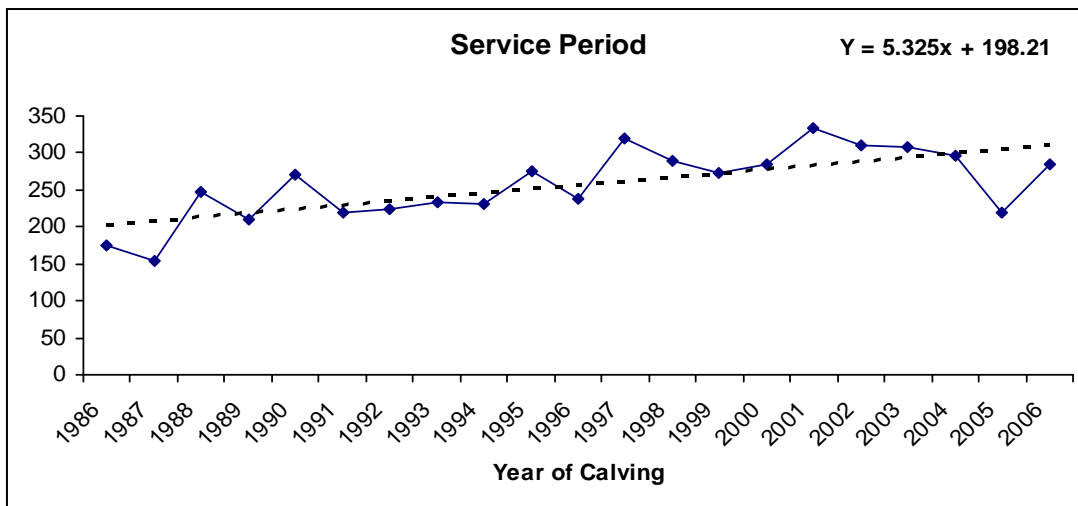


Figure 6. Phenotypic trend of first service period in different years of calving

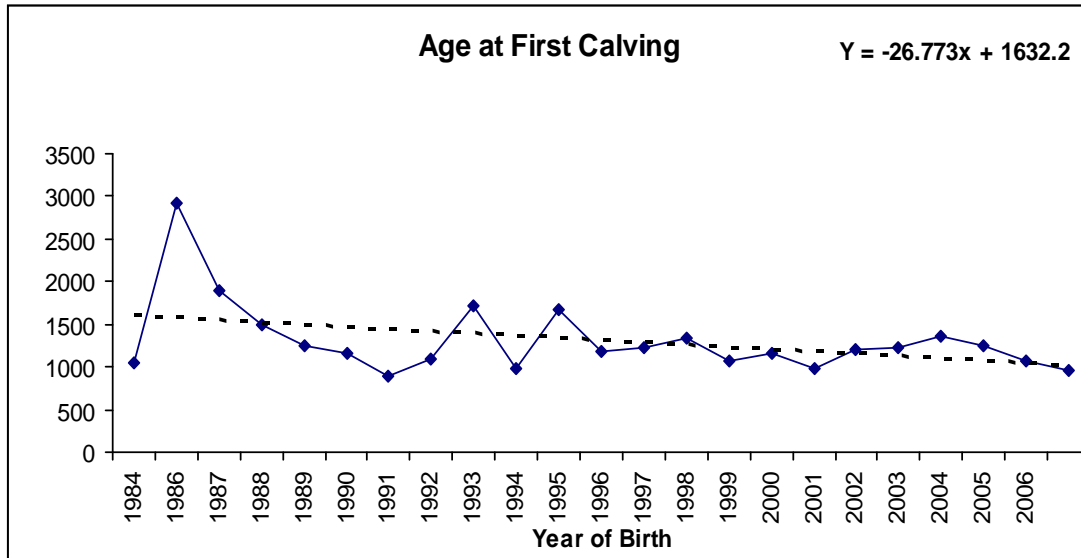


Figure 7. Phenotypic trend of age at first calving in different years of births

Conclusions: Performance of crossbred dairy cattle in first lactation in this study may be lower than earlier reports on crossbred cattle in Pakistan. This poor performance may be due to existing culling procedures used at military farms. Every female offspring born at military farms are retained for raising as cow to produce milk. No clear criteria are followed for selection of female calves born at farms. However selection criteria exist for bull mothers as male calves from only selected cows are kept for rearing and rest all are casted within two to three days after birth. Age at first calving has decreased over the years and this situation may be a result of better feeding/management and breeding. Weight is generally a neglected trait at most of the government farms. It can help to further identify deficiencies in the management and feeding system. Performance of crossbred cows of MF Neelum was much better from others for first lactation performance traits.

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