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Seasonal Stress Affects Reproductive and Lactation Traits in Dairy Cattle with Various Levels of Exotic Blood and Parities under Subtropical Condition

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ABSTRACT

The present study was conducted to investigate the effect of seasonal stress on economic traits with special emphasis on postpartum resumption of ovarian activities. Reproductive and productive records of crossbred dairy cows were analyzed at a large-scale state dairy farm from 1997 to 2013. Genetic groups consisted of HF 50.0%, HF 62.5%, HF 75.0% and HF 87.5%, having the respective levels of Holstein Friesian blood were studied in different seasons of the year. No significant differences were found between the groups with different exotic blood level in calving interval, age at first calving, postpartum ovulation interval and dry period. Calving interval, postpartum ovulation interval and dry period were significantly longer in the spring season while age at first calving was significantly longer in autumn. Significantly high milk production was found in HF 50%. Peak daily milk yield and lactation length were significantly higher in autumn and spring respectively. Animals with highest exotic blood levels showed the trend for prolonged calving interval probably due to reduced resistance to thermal stress. Cows with 50.0% exotic blood and those born in spring showed a slightly shorter age at first calving. The crossbred cows of genetic group HF 62.5% tended to show shortest ovulation intervals and the summer calvers showed significantly highest intervals. Based on results of this study it is suggested that cows calving in summer show lowest calving interval. Crossbred cows with 50% exotic blood showed earliest age at first calving, although non-significant. Crossbred dairy cows showed a constant upward trend in peak daily milk yield from first through sixth parity with a change of 18%. Peak mssilk yield declined up to 23% from parity 7 to 8. The finding may help the farmers in culling of the lactating cows to maintain an optimum herd average for milk production.

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Reproduction, Fertility, Ovulation, Cows, Crossbred, Stress, Season, Lactation

INTRODUCTION

Reproductive efficiency has an important role in breeding policy and milk production of cows. Genetic progress is dependent on having enough heifers for replacing old cows. For optimized calving rate and highest profitability, the annual production of live and healthy calves is necessary (Peters and Ball, 1995). A calving interval (CI) more than 365 days is generally associated with remarkable economic losses (Esslemont *et al*., 2000). To achieve 365 days of CI, the average days between calving to pregnancy must be 80-85 days (Peter and Ball, 1995). The reduction in reproductive performance by increasing the percent of exotic gene has been reported in a few studies (Roy *et al*., 1993; Asimwe and Kifaro, 2007).

Cross breeding with European dairy breeds has been widely used as a method to improve milk yield of dairy cows in tropical and subtropical regions. The first crossbred generation (F1) derived from indigenous (usually *Bos indicus*) female mated with exotic (*Bos taurus*) bulls performed very well in almost all cases. However, further upgrading by repeated crossing to the exotic breed gave variable and often disappointing results (Syrstad, 1996). Rege (1998) reviewed the results of 80 cross breeding experiments involving European and indigenous breeds in the tropics. High heterotic contribution to milk production traits in F_1 cows was reported and a significant deterioration was found in the performance of F2 generation in all traits compared with F_1 generation. Asimwe and Kifaro (2007) and Ahmed *et al*. (2007) reported that HF 75% and HF 87.5% groups had significantly different lactation days (305.09 and 347.07, respectively).

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Qureshi *et al*. (2000) concluded that productive and reproductive parameters of crossbred cattle in the province were satisfactory, showing adaptability to the local environment. Age at puberty was found as 752±10.9 days, inter-estrus interval as 20.0±9.07 days, and estrus duration ranged from 17 to 72 h. The prolonged estrus duration, not coinciding with the timing of ovulation was found to deteriorate reproductive performance constituting a major bottleneck in the crossbreeding program of the country. In a later study (Qureshi *et al*., 2002), the crossbred cows showed the lowest age at first calving in the rain-fed areas. The number of services per conception and calving interval were shorter in the hilly areas probably due to better management by the local farmers. The calving interval was positively correlated with the average daily milk production. The maximum crossbreeding was associated with shortening of age at first calving, dry period and calving interval, longer lactation length and higher daily milk yield. The feeding and management support was better as compared to the indigenous cows with little productivity and the financial return through the sale of progeny was also comparatively higher.

The farmers in the Khyber Pakhtunkhwa province of Pakistan prefer the crossbred dairy cattle because of higher milk yield and the unavailability of any local milk breeds of cattle in the province. The crossbred cows with higher levels of exotic blood are preferred and farmers try to get cows of higher levels of exotic blood by repeated backcrossing with HF sires. Different groups of crossbred dairy cattle are available to the farming community and at some large-scale state farms. Little information is available about the performance of higher-grade crossbred dairy cows (HF 75%, HF 87% and above) in the region. Information on interaction of stress factors with reproductive physiology and productivity is inadequate. Therefore, the present study planned to study changes in reproductive and productive performance of dairy cattle with different exotic blood levels, parities and seasons under subtropical environmental conditions. The objectives of the present study were to find the seasonal stress on calving interval, milk yield and lactation length in crossbred dairy cows.

MATERIALS AND METHODS

Data collection

Data from a total 1,131 lactations obtained from 1997 to 2013 consisting of various groups of crossbred dairy cows were utilized to study the influence of genetic group year, season of calving and parity on productive and reproductive traits. The genetic groups of crossbred cows consisted of HF 50%, HF 62.5%, HF 75% and HF 87.5%. The year of calving of the selected animals (1997 to 2013) was categorized into four seasons: winter (Dec-Feb), spring (Mar-May), summer (June-Aug) and autumn (September-November, Qureshi *et al*., 2002). The reproductive traits included calving interval, age at first calving, service period and dry period. The productive traits recorded were 305-day milk yield, peak milk yield and average daily milk yield and lactation length.

Outliers like daily milk yield less than 2 liters, peak daily milk yield less than 6 liters and lactation length above 500 days were excluded from the study. Similarly, for reproductive parameters, calving interval of more than 1,000 days, age at first calving above 4,000 days, dry period above 400 days and service period more than 730 days were considered outliers. The mean temperature humidity index (THI) during summer, autumn, winter and spring was 85, 65, 48 and 55, respectively.

Statistical analysis

Genotype, season of calving, parity and year of calving were taken as independent parameters. The genetic groups of the selected animals were categorized as HF 50, % HF 62.5%, HF 75% and HF 87.5%. Calving interval, service period, age at first calving and dry period were used as the dependent variable (reproductive economic traits). Average milk yield, 305-days milk yield, peak milk yield and lactation length were taken as dependent variables (lactation economic traits). The data were maintained in MS Excel files and analyzed through the general linear model using statistical package SPSS-16. Differences with P value less than 0.05 was statistically considered significant. Changes in various dependant parameters were plotted in graphs with equations reflecting quadratic regressions.

RESULTS

No significant variation in calving interval was found among the breed types (Table I) supporting that calving interval is mainly affected by environment and management strategies. However, the animals with highest exotic blood levels showed a trend for prolonged calving interval, which may be due to reduced resistance to thermal stress and loss of local genes. Calving interval increased linearly with an increase in exotic blood level from HF 50% to HF 87.5% (444±21 to 507±19 days) in crossbred dairy cows indicating deteriorating fertility status. Estimated marginal mean and SE analysis of variance supports that season of calving significantly affected the calving interval among various genetic groups of crossbred dairy cattle (Table I). A short calving interval was noticed in summer calvers followed by the next shortest calving interval in autumn calved crossbred cows.

Table I. Effect of genotype, season and year of calving on the reproductive traits of dairy cattle.

Parameters	Calving interval (days)	Age at first calving (days)	Service period (days)	Dry period (days)
Genetic groups				
HF 50%	466±33.6	1301±291	201.3±32.0	192.5±26.6
HF 62.5%	465±17.0	1485±143	171.0±15.4	166.6±9.7
HF 75%	468± 11.9	1486±80.0	177.1±10.4	176.6±7.3
HF 87%	490±21.8	1330±152.91	222.8±20.0	184.7±14.0
P-value	0.68	0.24	0.53	0.66
Season of calving				
Winter (Dec- Feb)	474±20.3	1360±173	201.0±18.5	172.1±12.4
Spring (Mar- May)	508±18.6	1236±125	229.0±16.3	195.4±12.3
Summer (Jun -Aug)	444±21.1	1242±148	160.2±19.0	170.9±12.6
Autumn (Sep -Nov)	464±18.2	1763±173	181.9±17.6	181.1±14.0
P-value	0.01	0.01	0.01	0.01
Year of calving				
1997	418±50.2	1302±550	179.8±73.4	191.3±50.2
1998	414±33.0	614±341	182.1±45.3	170.7±33.0
1999	427±29.1	800±378	298.1±38.5	175.1±29.1
2000	471±25.4	1005±369	134.9±36.9	195.5±25.4
2001	466±21.6	970±287	261.6±28.1	253.2±21.6
2002	490±27.5	1385±276	225.1±32.3	223.1±27.5
2003	514±21.7	1571±278	174.7±29.6	136.4±21.7
2004	529±18.4	1366±238	165.5±27.0	164.7±18.4
2005	484±19.3	1475±222	204.8±24.4	203.4±19.3
2006	434±17.2	1420±238	130.2±24.1	132.5±17.2
2007	447±17.1	1501±208	162.3±23.6	151.2±17.1
2008	412±15.9	1398±160	191.2±21.3	176.4±15.9
2009	512±15.0	1626±157	227.3±20.4	164.1±15.0
2010	484±13.8	1737±153	237.6±18.5	187.8±13.8
2011	533 ±13.2	1809±154	258.5±18.2	189.1±13.2
2012	581±12.2	2037±146	251.6±17.5	201.1±12.2
2013	506±9.9	1756±122	215.8±14.2	168.8±9.4
P-value	0.01	0.01	0.01	0.01

MY, milk yield; DMY, daily milk yield; LL: lactation length, HF 50%; HF 62.5%, HF 75%, HF 87%, dairy cows with the respective percentage of Holstein Friesian genotype.

Year of calving had a significant effect on reproductive traits of crossbred cows (Table I, Fig. 1). The lowest and highest calving intervals were observed as 412±16 days in year 2008 and 581±12 days in year 2012. Fertility management in particular years could have positive and negative effects on reproductive traits in crossbred dairy cows.

The younger and older age at first calving was recorded as 614±341 days in 1998 and 2037±146 days in 2012. The shortest service period was noted in 2006 as 130±24 days while the longest service period was 298±38 days in 1999. The shortest and longest dry period recorded was 133±17days in 2006 and 253±22 days in 2001, respectively.

No significant difference was found in age at first calving among various genetic groups of crossbred dairy cows (Table I). The data trend indicates that HF50% group possessing slightly shorter age at first calving followed by

HF87% group. The values recorded for different genetic groups of crossbred cattle are (1301±291, 1485±143, 1486±80.0, and 1330±152.91) days in HF 50%, HF 62.5%, HF 75% and HF 87.5%, respectively. A significant effect of season of calving was noted on age at first calving. The calves born in spring season reached to earlier maturity followed by summer born progeny in this study.

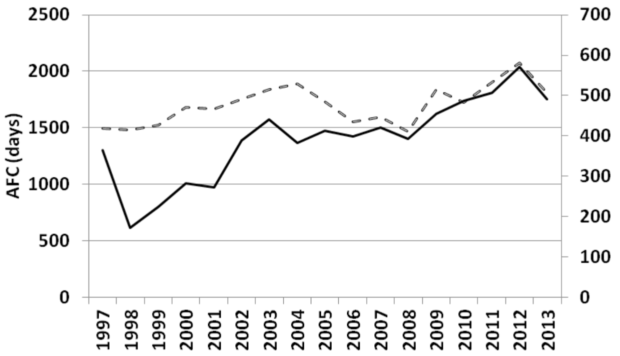

Fig. 1. Effect of year of calving on age at first calving (AFC, solid lines; y = 6.6048x + 415.47; R^2 =0.39) and calving interval (CI, dashed lines, y = 63.451x + 827.42; R^2 = 0.73) in dairy cattle.

A significant effect of year of calving was recorded on age at first calving (Table I). The year 2011 and 2012 were the worst years with longer age at first calving while in the year 1998 and 1999 had shown shorter age at first calving. No difference was recorded in service period among the different groups of crossbred dairy cattle (Table II), however the data trend showed that HF 62.5% possessed shorter service period followed than by HF 75% group (171.04±15.4 and 177.06±10.4 days, respectively). The mean valves of service period in the present study are very high as compared to the ideal service period of 85-90 days in the modern dairying, reflecting poor reproductive management at the state farm.

Table I shows that season of calving significantly affected service period in the crossbred dairy cattle. Cows calved in summer showed a short service period followed by autumn calvers in the present study (Table I). Year of calving had a significant effect on service period. Shorter and longer service periods were observed as 130.20±24.1 days and 298.12±38.5 days in 2006 and 1999, respectively. There was no difference in the dry period among different genetic groups of crossbred cattle in this study. The result indicates that HF62.5% showed a short dry period of 166.64±9.65 days was followed by HF 75% group.

Season of calving significantly affected the dry period of crossbred dairy cattle (Table I). Cows calved in summer showed shorter dry period of 170.91±12.6 days while longest dry period was noted during spring (195.42±12.3 days). Lactation traits analysis for 305 days milk yield indicated almost significant difference among different exotic blood levels in crossbred dairy cows (Table II, P=0.057) HF50% group produced largest quantity of milk followed by HF75% HF87% and HF62.5% (2620.8±50.9, 2605.03± 27.4, 2555.81± 38.5 and 2497.09± 34.2, respectively. Season of calving had no significant effect on 305 days milk yield. However, the data trend showed that winter calvers produced more milk followed by cows calved in spring, summer and autumn showing effect of heat stress in summer and its carry over effects in autumn.

Parity showed a significant effect on 305 days and peak milk yield in crossbred dairy cows (Table II, Fig. 2). The lowest 305 days milk yield and peak milk yield recorded in parity 8 and 1, respectively. No significant effect of genetic groups of cross breed cows (HF 50% HF 62.5%, HF 75% HF 87.5%) were observed on average daily milk yield, peak daily milk yield, and lactation length.

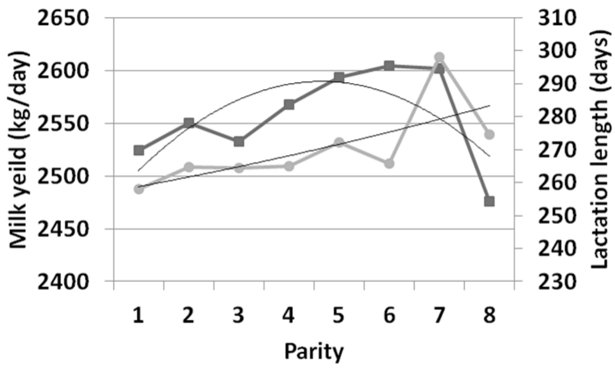

Fig. 2. Effect of parity on 305 days milk yield (solid squares; y = 1.9164x + 2547.5; R^2 = 0.01) and lactation length (solid circles; y = 3.5023x + 254.57; R^2 = 0.48) in dairy cattle.

Season of calving significantly affected peak milk yield among various genetic groups sof crossbred dairy cattle calved in different year of season (Table II). The highest peak milk yield was observed in autumn followed by summer, winter and spring season calvers. No significant difference was found in lactation length of crossbred dairy cattle groups of different exotic blood level. The data trend revealed a longer lactation length in HF87.5% (281.23±6.95 days). Season of calving had significant effect on lactation length (P<0.01). Winter and spring calvers produced milk for longer periods. Parity has a significant effect on lactation length in crossbred dairy cattle showing high value during parity 7, 8 and 5.

Table II. Effect of genotype, parity and seasons of lactation on milk yield parameters in dairy cows.

Parameter	305-d MY* (liters)	Avg. DMY (liters)	Peak DMY (liters)	LL (days)
Genetic groups				
HF 50%	2620±50	9.92±0.29	12.90±0.71	269.0±6.9
HF 62.5%	2497±34	9.84±0.18	13.55±0.42	263.6±54.0
HF 75%	2605±27	10.10±0.18	13.50±0.30	266.9±3.4
HF 87%	2556±39	10.48±0.24	13.44±0.55	281.2±7.0
P-value	0.06	0.64	0.58	0.97
Season of calving				
Winter (Dec- Feb)	2608±33	10.08±0.18	13.01±0.41	276.5±5.2
Spring (Mar- May)	2591±33	10.03±0.18	12.66±0.40	276.5±5.4
Summer (Jun -Aug)	2559±34	9.99±0.18	13.31±0.42	263.1±5.7
Autumn (Sep -Nov)	2542±31	10.16±0.17	14.33±0.39	262.1±4.6
P-value	0.44	0.58	0.01	0.01
Parity				
1	2524±28	10.13±0.14	12.22±0.29	258.1±3.5
2	2550±19	9.96±0.15	12.62±0.32	264.7±3.8
3	2533±3	9.73±0.16	13.30±0.37	264.3±4.3
4	2567±37	10.06±0.20	13.66±0.48	264.9±5.4
5	2593±42	9.83±0.22	13.95±0.56	272.3±6
6	2605±50	9.85±0.25	14.47±0.64	265.7±7.7
7	2601±58	11.10±0.37	13.91±0.82	298.2±12.
8	2476±63	9.68±0.35	11.19±0.92	274.5±12.5
P-value	0.01	0.01	0.07	0.06

For abbreviations and other details, see Table I.

DISCUSSION

From the results of the present study, it seems that that calving interval is mainly affected by environment and management strategies reflected by variation among the season and years rather than genetic difference. Qureshi *et al*. (2000) observed higher calving interval, while Rafique *et al*. (2000) reported similar findings in crossbred cows maintained under farm conditions and formal management at state farms, respectively. Delayed ovulation has been found as a causative factor for a prolonged service period leading to prolonged calving interval (Qureshi *et al*., 2000). The prolonged estrus duration showed a stronger correlation with the number of services per conception according to the personal experience of the authors.

The longer values of calving interval may be due to the late assumption of post parturient ovarian activities triggered by poor BCS, anestrus / weak estrus signs and lack of proper heat detection methods. The reason for summer calvers showing short calving interval in this study, may be managemental, low milk yield and better BCS, sparing more nutrients for reproductive cyclicity rather than lactation. The other factor is the succeeding autumn season of low ambient temperature and availability of abundant quantity of green maize for animal feeding. The decreasing photoperiod during autumn, apparently favoured reproductive cyclicity in the crossbred dairy cows. The longest calving interval was noted in spring calvers, probably due to summer infertility during the succeeding season (Thompson *et al*., 1996).

Season of calving significantly affected the calving interval among various genetic groups of crossbred dairy cattle in the present study. Asimwe and Kifaro (2007) recorded similar result in rainy season in crossbred dairy cattle in HF 50% and above and concluded that it was expected because cows/heifers that calved during the wet season received sufficient feeds in term of quality and quantity, thus could recover within short time compared to those that calved in long dry season where there was inadequate nutrition. The results of the present study are in close agreement with their findings.

This study suggests that cows calving in summer show lowest calving interval, probably due to earlier resumption of estrous activities during the succeeding autumn, with no summer stress and more availability of energy fodders. In addition, the animals during this period are kept open, moving freely in the open yard; hence supporting reproductive activities.

No significant difference of age at first calving was noted among crossbred dairy cows Table I. However, the data trend indicates that HF 50% crossbred cows possessing slightly shorter age at first calving followed by HF 87.5%. The values recorded for different groups of crossbred dairy cows are 1301.07±291, 1485.35±143, 1486.16±80 and 1330.17±152 days in HF 50%, HF 62.5%, HF 75% and HF 87.5%, respectively.

Ahmed *et al*. (2007) reported similar age at first calving for different groups of Zebu x Friesian crossbred cows, while lower values were found by Duguma *et al*. (2012) in Zebu x Holstein Friesian crossbred cattle. Eleman *et al*. (2012) noted comparatively longer days for age at first calving than the value of the present study. Asimwe and Kifaro (2007) concluded that F1 crosses were found to calve earlier than the high-grade counter part heifers. This statement is true for the result of HF 50% in the present study, where HF 50% cow's attained earlier age at first calving than the higher grade crossbred groups.

The variation in age at first calving recorded in different research projects could be attributed to differences in the calf rearing system heifer management. Differences in terms of feeding, housing and health care are the common observations in the developing countries. In the present study, the autumn born calves attained a very late maturity, which may be due to poor calf rearing system and cold stress in the succeeding winter season at the farm. The finding of Asimwe and Kifare (2007) and Rafiq *et al*. (2000) are in line with the results of the present study. The variation among the age at first calving in different years might be due to the difference in care of young stock and heifers by the manager and its staff during a particular year.

Crossbred cows with HF 50% genetic group showed the earliest age at first calving. Age at first calving may be further reduced through breeding management in a manner to get maximum calvings during spring up to late summer. The spring and summer benefit is probably due to lack of cold stress and abundant availability of quality fodders with higher dietary energy values.

The mean values of service period in the present study (130±24 up to 298±38 days) are very high as compared to the ideal service period of 85-90 days in the modern dairying (Britt, 1975). Rafiq *et al*. (2000), Asimwe *et al*. (2007) and Bahmani *et al*. (2011) reported a similar higher and short service period respectively in different crosses of hybrid animals. The service period is mostly affected by management including feeding, housing system, proper heat detection techniques, and timely insemination of cow and proper skills of inseminator.

In the present study, the higher value for service period or days open may be indicative of heat stress, repeat breeding and delayed ovulation in crossbred dairy cattle and suboptimal management at the farm. The reasons for a longer service period in the present study may be poor fertility, feeding management and silent estrus due to stressful weather condition and delayed ovulation. Better management can improve the service period and calving interval in crossbred dairy cattle.

The reasons for short service periods recorded during summer and autumn may be low milk yield, maintaining good body condition score and the reduced stress associated with declined ambient temperatures during autumn and winter (Bahmani *et al*., 2011).

The result of our study is in line with those of Younas *et al*. (2008) and Mustafa *et al*. (2003) who reported a significant effect of year of calving on the service period in Fresian and Red Sindi cattle.

This study suggests that cows calving in summer conceived earlier, probably due to decreasing ambient temperatures and increased fodder supplies during the succeeding autumn months. In addition, the animals during this period are allowed for grazing and housed in open yards; hence supporting reproductive activities.

The dry period in the present study is quite higher than the ideal dry period of 60 days in modern dairying. The finding of our study is close to the value recorded by Rafiq *et al*. (2000) for F_2 inter se mating of HFxShiwal, FAdlelmoula *et al*. (2007) from the findings of various groups of crossbred cattle concluded that dry period was significantly ($P<0.05$) affected by lactation number, season and the period of calving and their interaction. The reason of the shorter dry period in summer season in crossbred dairy cattle in the present study may be due to low milk production in the hot summer in their early lactation stage, maintaining good body condition score and a next season (autumn) with declined temperature in which the cows exhibits a proper estrus and get early pregnancy.

Year of calving had a significant effect ($P<0.01$) on dry period in crossbred dairy groups in present study Table I. The values of dry period were longer than standard dry period. The reason might be lack of proper drying off system at state farm. Drying off is practiced usually at state farm on the basis of daily milk yield, availability of feed and stage of pregnancy. Additional factor is personal decision of the manager. These factors may change with the year. In fact cows low production and long service period, the dry period may naturally be longer.

Analysis of variance of data of 305 days milk yield indicates significant difference (P=0.057) among different genetic group of crossbred cows (Table II). HF 50% group produced more milk followed by HF 75%. The reason of higher milk yield produced by HF 50% crossbred cows may be the presence of more local blood having better resistance against thermal stress of sub tropical environment.

The result of the present study regarding 305 days milk yield is in agreement with the finding of Ahmed *et al*. (2007) and Banda (1996) in crossbred dairy cattle. The reason for increased milk yield by cross dairy cattle in winter and spring season may be due to the pleasant climate in autumn when they were in advanced pregnancy. The cows were in a stress free weather condition of the winter season with the availability of good quality green roughages (Egyptian clover) for feeding in their early lactation stage. Similarly, a spring season calvers might be fed green legumes ad-libitum in their early lactation stage during favourable environmental condition.

This study suggest that higher milk yield is associated with HF 50% crossbred cows which might be due to hetrosis. In addition this genetic group also show better resistance against thermal stress and disease occurrence, in sub-tropical environment.

No significant effect of exotic blood level group on average dairy milk yield (Table II) however the data trend shows that crossbred cow HF 87.5% produced more milk per day followed by HF 75%. The reason for high daily milk production in HF 87.5% and HF 75% may be due to the presence of higher genetic worth for dairy characteristics in these cross dairy cows. The finding of Lakshmi *et al*. (2009) supporting the finding of present study.

Parity has significant (P=0.000) effect on 305 days and peak milk yield in crossbred dairy groups (Table II, Fig. 3). The highest milk yield recorded in parity 6 followed by parity 7. The reason for higher milk production in these parities might be maximum development of body framework, organs and tissues of cross bred cows.

The lowest 305 days milk yield and peak milk yield were recorded in parity 8 and 1. The present result is in line with the finding reported by Lakshmi *et al*. (2009) and Tadesse *et al*. (2010), Ahmed *et al*. (2007), Islam and Kundu (2011), FAdlelmoula *et al*. (2007), and Banda (1996) also reported that parity had a significant effect on production performance in crossbred and Holstein Friesian cows. In the present study, the difference in 305 days milk yield and peak milk yield is not significant from first to third parity and cows have produced a similar quantity of milk. The reason might be the older age at first calving and cows has used maximum nutrients for maintenance and production and less for body growth.

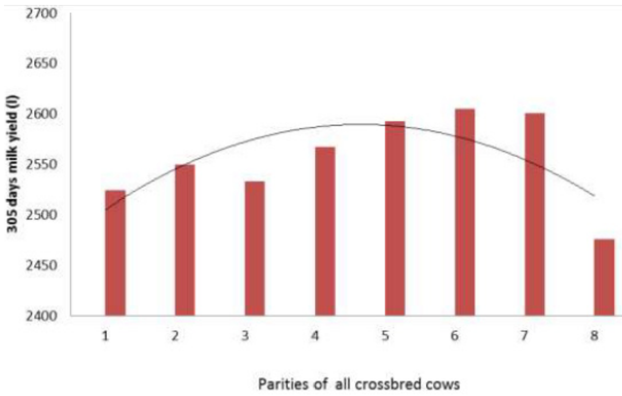

Fig. 3. Changes in 305 days milk yield with the increasing parities in crossbred dairy cows ($y = -6.340x^2 + 58.97x + 2452$, $R^2 = 0.49$)

In the present study, the highest peak daily milk yield in autumn calvers, cows may be due to availability of quality green fodder like maize, legume for stall feeding and grazing when they were in advanced pregnancy in summer season. Good BCS at the time of their calving and favorable decline in thermal stress in succeeding season (Sep-November) could be the possible reasons. The reason for summer calvers crossbred dairy cattle yielding more peak milk compared to winter and spring are mainly due to adoptability of crossbred cows to sub-tropical environmental condition and better feeding, housing management of the cows in this season.

Das *et al*. (2011) and Ahmed *et al*. (2007) reported that the effect of year-season of calving on lactation and daily milk yield were highly significant. Banda (1996) and Okeyo *et al*. (2001) also reported a similar finding that year and season of calving significantly affected milk yield.

This study suggests that crossbred dairy cows showed a constant upward trend in peak daily milk yield from first through sixth parity with a change of 18.41%, which declined up to parity 8 up to 22.67%. The initial increase may be due to maturity of the animal body while the decrease may be due to aging effect after attaining the maximum level of peak milk yield. This finding may help the farmers in culling of the lactating cows to maintain an optimum herd average for milk production. Summer and autumn calving also supported better peak daily milk yield.

The data trend revealed a longer lactation length in HF 87.5%. The results were slightly lower than those reported by Ahmed *et al*. (2007) while Lakshmi *et al*. (2009) and Qureshi *et al*. (2000) reported higher lactation length values than the present study. Bello *et al*. (2009) reported a shorter lactation length. Longer and shorter value for lactation length may be attributed to lack of proper management, miss adaptation of certain programs in drying off lactating cows and post partum breeding management of herd.

Winter and spring calvers produced milk for longer period. The reason for the longer lactation length in winter and spring season calvers may be pleasant climatic condition and availability of quality green fodder, (maize and Egypitican clover) in their late stage of lactation in autumn and winter season. Amasaib *et al*. (2008) concluded that season of calving plays an important role in most of the productive trait in dairy animals. Environmental effects of herd year-season, parity, sire and area of origin, milk yield class and stage of lactation significantly affected the length of productive life (Amasaib *et al*., 2008).

The lactation length in crossbred dairy cattle in parity 7, 8 and 5 was supported by the findings of Islam and Kundu (2011). The results noted by Lakshmi *et al*. (2009) are in close comparison to the present results and lowest value of parity 1. Ahmed *et al*. (2007) reported highest lactation length in first parity, while the lactation length in parity 2, 3 and 4 were of similar length. Banda (1996) concluded that parity affected all productive traits, including lactation length in crossbred cows. Okeyo *et al*. (2001) also reported that parity had a significant effect on milk yield and lactation length in Holstein Friesian dairy cattle while Bello *et al*. (2009) and Diack *et al*. (2005) reported that parity has a non significant effect on lactation length and milk yield.

CONCLUSION

Based on results of this study it is suggested that cows calving in summer show lowest calving interval. Crossbred cows with 50% exotic blood showed earliest age at first calving, although non-significant. Crossbred dairy cows showed a constant upward trend in peak daily milk yield from first through sixth parity with a change of 18%. Peak mssilk yield declined up to 23% from parity 7 to 8. The finding may help the farmers in culling of the lactating cows to maintain an optimum herd average for milk production.

Statement of conflict of interest

We declare no conflicts of interest in this study.

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