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Reproductive Performance Evaluation of Holstein Friesian and Their Crosses with Boran Cattle Breeds in Ardaita Agricultural Technical Vocational Education Training College Dairy Farm, Oromia Region, Ethiopia

Research Article

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ABSTRACT

The study was conducted at Ardaita Agricultural Technical Vocational Education Training (ATVET) college dairy farm, to evaluate the reproductive performance of Holstein Friesian and its crosses with Boran cattle breeds. Data collected between 2000 and 2015 on reproductive traits (n=2632) were studied and analyzed using general linear model procedure. The overall estimated means for age at first service (AFS), age at first calving (AFC), calving interval (CI), days open (DO) and number of services per conception (NSC) were: 31.33 ± 0.44 months, 41.08 ± 0.44 months, 405.50 ± 3.32 days, 134.84 ± 3.51 days and 1.36 ± 0.03, respectively. Except age at first service, which is influenced by level of Holestien Friesian percentage, season of calving and level of Holestien Friesian percentage was not significant (P>0.05) on all reproductive traits. The traits calving interval and days open significantly (P<0.001) influenced by year of calving and parity. Season of birth (P<0.05) and year of birth (P<0.001) significantly influenced age at first service and age at first calving. Service per conception was significantly influenced by year of calving (P<0.001) only. Except number of service per conception, the result obtained for age at first service, age at first calving, days open and calving interval of Holstein Friesian and its crosses with Boran cows in the study area were below the standards set for commercial dairy farms. Therefore, consideration should be given to the farm to improve those genetic and non-genetic factors affected performance.

KEY WORDS Ardaita, crossbred, Holstein Friesian, reproductive performance.

INTRODUCTION

Ethiopia has the largest livestock population in Africa. The cattle population in Ethiopia is estimated to be 54 million heads, with about 55% females (CSA, 2013). Livestock production constitutes to be an important sub-sector of the agricultural production in Ethiopia, contributing 45% of the total Agricultural Gross Domestic Product (IGAD, 2010). With rapid population and income growth, and increasing urbanization, the demand for livestock and livestock products is growing, presenting huge opportunities for the sector. Even though livestock sector has a significant contribution to the Ethiopian economy but production per animal is extremely low (Kumar and Tkui, 2014). Poor reproductive performance of dairy cows in Ethiopia could be related to genetic, environmental/management factors or both. In order to improve the low productivity of local cattle, selection of the most promising breeds and crossbreeding of these indigenous breed with high producing exotic cattle has been considered as a practical solution (Bekele, 2002).

In this regard, selection among indigenous breeds is a huge task and will take too long to arrive at an acceptable production level. Therefore crossbreeding has long been practiced in Ethiopia to combine the high yield of the European dairy breeds with the toughness of indigenous breeds. Besides their genotype, the performance of dairy animals is also affected by many environmental factors. Un favorable environmental factors may suppress the animal's true genetic ability and create a bias in the selection of animals (Lateef *et al*. 2008). It has been well documented that, to increase production, improving environmental condition and management practices coupled with improving genetic potential of dairy animals is an effective approach (Lateef, 2007).

Appropriate periodical evaluation of factors affecting reproductive performance of animals is very important for future planning and management. Previous studies have been conducted to evaluate the productive and reproductive performances of dairy cows at institutional large scale dairy farms (Goshu *et al*. 2007; Fekadu *et al*. 2010; Abera *et al*. 2010; Tadesse *et al*. 2010). However, information is limited about the productive and reproductive performance of dairy cows in different dairy farms, particularly in Ethiopia (Lobago, 2007). Thus there is a need to have data of animals under different farming conditions. The few data from studies on the performance of Holstein Friesian and its crosses with indigenous cattle in Ethiopia are not enough. Moreover, there are not studies that show the reproductive performance of Holstein Friesian and HF × Boran crossbred dairy cows.

Ardaita dairy farm is among the oldest state farms in Ethiopia, where Holstein Friesian and HF × Boran crossbred dairy cows kept. This study was designed to measure and compare various parameters of reproductive performance of Holestien Friesian and HF × Boran crossbred dairy cows.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Ardaita ATVET College dairy farm, which is situated 305 kilo meters far away to southeast of Addis Ababa. The farm is surrounded with farm lands at is at an altitude of 2410-2610 meter above sea level with 4˚17'20" north latitude and 37˚11'30" east longitude in south eastern Ethiopia of Oromia National Regional State in the high land of Arsi zone. The mean annual rain fall is 1200 mm and maximum and minimum temperature ranges from 20 ˚C and 5 ˚C, respectively.

The area has three distinct seasons. A short rainy season which extends from March to June, a long rainy season, which extends from July to October and a dry season that extends from November to February (NMSA, 2010). The dominant soil types are black clay soils with sand–silt clay having a pH of 7.9.

Establishment of the farm and breed groups

The Ardaita dairy farm was established in 1984 by purchasing 50 first crosses of HF × Boran dairy cows. The farm then started milk production with a herd of Holstein Friesian and HF × Boran crosses.

Animal management

Animals were kept under an intensive feeding and production systems. Herds were divided in groups based on sex, age, time of calving and lactation. Animals were liberally stall fed with green fodders and roughages, concentrates were also fed to the animals according to the need (Table 1). Heifers and dry cows were mainly fed on green fodder and other roughages throughout the year. Semen of pure bred Holestien Friesian Bulls from the National Artificial Insemination Center was used for insemination. The insemination was carried out by AI technicians. Detection of estrus was carried out twice a day, early in the morning and late in the afternoon. During the rainy season of the day, cows were grazed on pastures from 2:00-3:00 am local time. Later on the day animals were tied and fed with dry and green fodder, concentrates and mineral licks while being in the shade. Animals were fed according to calculated requirements with concentrate feeds and mineral licks during late pregnancy and lactation (Table 2). Non-lactating cows were only given hay. Lactating cows were received 1 kg concentrates per 2.5 kg of milk produced before each milking. Hay produced from various types of annual and perennial plants of graminaceous and leguminous species were used for feeding animals (Table 3).

Pregnant cows were managed separately during the last trimester. Calving was in well-constructed calving pens. Newborn calves were taken away from their dams shortly after birth and were given colostrums for the first five days age. Fresh milk was offered twice a day in a bucket till the age of 6 months. They were kept in individual pens. Lactating cows were hand-milked twice daily, early in the morning (4:00-5:00 p.m.) and late in the afternoon (3:00-4:00 p.m.).

Animals were regular vaccinated against anthrax, pasteurellosis, blackleg, foot and mouth disease, lumpy skin disease, and contagious bovine pleura pneumonia. Internal and external parasitic infestation were dewormed and sprayed regularly.

Table 1 Ingredients used to make concentrates in Ardaita dairy farm

Classes of animals	Grain (%)	Noug seed cake (%)	Wheat bran (%)	Wheat short (%)	Salt (%)	Lime (%)
Calves	23	25	20	20	1	1
Heifers	20	30	28	20	1	1
Lactating	20	30	27	20	1	1

Table 2 Recommended levels of concentrate feed in Ardaita dairy farm

Classes of animals	Concentrate fed
Heifer	3 kg
Pregnant	3 kg at the last trimester
Lactating	1 kg/2.5 liter of milk produced
Dry cows	2 kg

Table 3 Legumes and grasses used to make hay in Ardaita dairy farm

Legume species	**Grass species**
Vigna unguiclata	*Sorgum sudanese*
Dolichos lablab	*Cynodon dactylon*
Cajanus cajan	*Chloris gayana*
Dismodium intortum	*Cenchurs ciliaris*
Dismodium unicinatum	*Punisetum purperium*
Medicago sativa	-

Data collection

The data concerning reproductive performance of the farm was collected for the period from 2000 to 2015 G.C. Parameters of reproductive performance were calculated. These include age at first service (AFS), age at first calving (AFC), days open (DO), calving interval (CI) and number of services per conception (NSC). The compiled record cards were checked for completeness and unclear and incomplete data were cleaned out.

Data analysis

The data were entered into Microsoft excel spread sheet and the reproductive traits (AFS, AFC, DO, CI and NSC) were analyzed by the general linear model (GLM) procedures using of the SAS (SAS, 2008). Cases that aborted or had still birth were removed from the data bases. The model included fixed effects of level of HF percentage (75% HF, 87.5% HF and 100% HF), season, parity and year (2000-2015 G.C). The year were divided into 3 seasons based on rain fall distribution; a short rainy season which extends from March to June, a long rainy season, which extends from July to October and a dry season that extends from November to February. Although the maximum parity in the original data was 10. There were too few animals with a parity ≥ 7 for further meaning full analysis. Therefore, all parities above 7 were pooled together in parity ≥ 7. For DO, CI and NSC, the number of observation of animals that calved during 2002 and earlier were too small, therefore all animals that calved prior to 2002 were pooled with those from 2002. Likewise the number of observation of animals that calved during 2014 and later were too small. Therefore, all animals that calved in 2014 and above were pooled together in 2014.

For AFS and AFC cows born during 2000 and 2001 were included. Preliminary analysis showed that interaction effects of the fixed factors were not significant and thus not included in the model. The following statistical models were used to analyze reproductive traits in the farms.

Model 1: age at first service (AFS) and age at first calving (AFC) were analyzed using the following model:

$$Y_{ijk}= \mu + B_i +S_j + Y_k + e_{ijk}$$

Where:
Y_{ijk}: n^{th} record of i^{th} level of HF percentage.
j^{th}: season of birth and k^{th} year of birth.
μ: overall mean.
B_i: fixed effect of i^{th} level of HF percentage (75% HF and 87.5 HF% and 100% HF).
S_j: fixed effect of j^{th} season of birth (long rainy, short rainy and dry season).
Y_k: fixed effect of k^{th} year of birth (2000-2015 G.C).
e_{ijk}: random error associated with each observation.

Model 2: calving interval (CI), days open (DO) and number of service per conception (NSC) were analyzed using the following model:

$$Y_{ijklm}= \mu + B_i + S_j + P_k + H_l + e_{ijkl,}$$

Where:
Y_{ijkl}: observation on NSC, DO and CI trait over n^{th} record of level of HF percentage.
j^{th}: season of calving.

l^{th}: year of calving.
k^{th}: parity.
μ: overall mean.
B_i: fixed effect of i^{th} level of HF percentage (75% HF, 87.5% HF and 100% HF).
S_j: fixed effect of j^{th} season of calving (long rainy, short rainy and dry season).
P_k: fixed effect of k^{th} parity of Dam (1…7).
H_l : fixed effect of l^{th} year of calving (2000-2015 G.C).
e_{ijkm}: random residual error.

RESULTS AND DISCUSSION

Age at first service (AFS)

The overall least square mean and standard error of AFS of Holstein Frisian and HF × Boran crossbred dairy cows was estimated to be 31.33 ± 0.44 months with coefficient of variation 17.11%. The mean AFS found in this study was higher than 23.2 months for local × Holstein Friesian as reported by Ibrahim *et al.* (2011), 24.30 ± 8.01 months for Zebu × Holstein-Friesian dairy cows in Jimma town, Ethiopia (Belay *et al.* 2012), 25.6 months for crossbred dairy cows in eastern lowlands of Ethiopia (Mureda and Mekuriaw, 2007). Besides, the result was higher than the report of Yohannes Shiferaw *et al.* (2003) who found that AFS of 29.58 months for crossbred dairy cows in central highland of Ethiopia, Dinka (2012) reported that the mean AFS as 24.9 months for smallholder cross breed cows in Asella. This longer AFS of Holstein Friesian and HF × Boran crossbred dairy cows in Ardaita farm might be due to poor management of heifers than most reports in the tropics.

Results are given in Table 4. The level of HF percentage (P<0.05), season of birth and year of birth (P<0.001) significantly influenced AFS. Animals with 87.5% Holstein Friesian percentage were younger at age at first service, while purebred Holstein Friesian cows were older (Table 4). The precocity of animals with 87.5% Friesian blood likely benefited more from the last 12.5% of genes coming from the local breed in adapting to highland condition than cattle that were 75% HF or 100% HF.

Fekadu *et al.* (2010) reported similar findings regarding the effect of season of birth on AFS. But on purebred HF cows this was less clear (Lemma *et al.* 2010; Tadesse *et al.* 2010) under Ethiopian conditions. After the rainy season, grass on natural pastures develops rapidly and lasts through dry season, therefore AFS is affected by the chances for young cattle to benefit from the wealth of grass. In order to do this calves must be able to digest fiber.

Calves born in the dry season tended to be younger at first service and calving than those were born in short, and long rainy season of Holstein Friesian cows at Alage dairy farm (Fekadu *et al.* 2010). The significant effect of year of birth on AFS reported in this study is in agreement with the reports of Iffa *et al.* (2006); Tadesse *et al.* (2010); Fekadu *et al.* (2011) and Menale *et al.* (2011). In contrast, it disagreed with the report of Tadesse *et al.* (2006) in Ethiopia. The trend of AFS was inconsistence (Figure 1). The lowest value of AFS was recorded in cows that were born during 2003 and 2004, whereas the highest value recorded with the cows that were born during 2008 and 2010, respectively. Age at first service showed a decreasing trend over the years between 2000 and 2004, while increasing trend from the cows that were born during 2005-2010 (Figure 1). As a result AFS is affected by management and climatic fluctuation in the years.

Age at first calving (AFC)

The overall least square mean and standard error of AFC of pure Holstein Frisian and HF × Boran crossbred dairy cows was estimated to be 41.08 ± 0.44 months with coefficient of variation 13.49%. This is comparable with Ayalew and Assefa (2013) who reported AFC of 40.9 ± 6.6 months for crossbred dairy cows in north Shoa zone and 40.6 months for crossbred dairy heifers in different dairy production systems in central highlands of Ethiopia reported by Yohannes Shiferaw *et al.* (2003). It is higher than 38 months for Boran and its crosses with Friesian and Jersey breed in tropical highlands of Ethiopia as reported by Demeke *et al.* (2004b), 32.1 months for crossbred cows under smallholder condition in Ziway as reported by Yifat Denbarga *et al.* (2009) and 34.7 months for crossbred cows in Gonder, Ethiopia by Ibrahim *et al.* (2011). The difference of AFC reported in the present study with other findings might be due to difference in the level of Holestien percentage, and management variation during calf rearing period and problem of heat detection. A number of previous works indicated that management factor especially nutrition determines pre-pubertal growth rates and reproductive development (Negussie *et al.* 1998; Masama *et al.* 2003).

Results are given in Table 4. Season of birth (P<0.05) and year of birth (P<0.001) significantly influenced AFC, while the effect of HF blood percentage (P>0.05) was not significant.

Similar significant effect of season of birth on AFC reported by Chenyambuga and Mseleko (2009) in Tanzania, Demeke *et al.* (2004b) and Tadesse *et al.* (2006) in Ethiopia. But this was different from the findings of Lemma *et al.* (2010) and Tadesse *et al.* (2010) for purebred HF cows in Ethiopia.

Cows that was born during long rainy season attained AFC higher than those were born during dry and short rainy season, respectively.

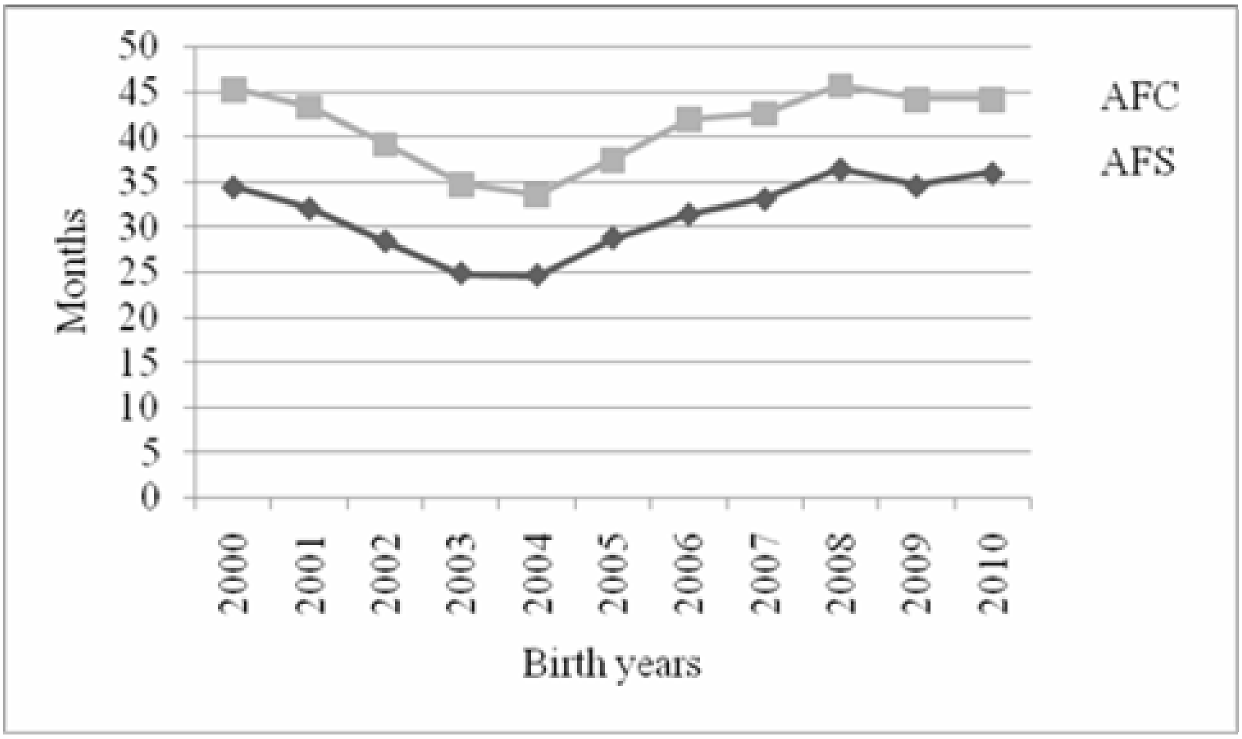

Figure 1 The trend of age at first service (AFS) and age at first calving (AFC) over year of birth at Ardaita College

Table 4 Least square means (LSM±SE) of age at first service (AFS) and age at first calving (AFC) of Holstein Friesian and HF × Boran crossbred dairy cows over the fixed effects of cross-breed percentage, season of birth and year of birth

Factor		AFS (months)	AFC (months)
	N	LSM ± SE	LSM ± SE
Overall	218	31.33±0.44	41.08±0.44
Coefficient of variation (CV) (%)		17.11	13.49
Season of birth		*	*
Long rainy	86	32.72±0.65[a]	42.12±0.66[a]
Short rainy	66	29.81±0.72[b]	39.35±0.73[b]
Dry season	66	31.46±0.77[ab]	41.76±0.76[ab]
Level of cross-breed		*	NS
¾ Friesian × ¼ Boran	65	31.40±0.95[ab]	40.95 ±0.96
$^7/_8$ Friesian × $1/_8$ Boran	78	29.88±0.68[b]	40.16±0.66
Holstein Friesian	75	32.71±0.69[a]	42.13±0.70
Year of birth		***	***
2000	55	34.43±0.87[ab]	45.25±0.86[a]
2001	10	32.05±1.76[ab]	43.35±1.81[ab]
2002	16	28.43±1.42[bc]	39.10±1.41[ac]
2003	18	24.81±1.40[c]	34.70±1.37[c]
2004	24	24.59±1.15[c]	33.52±1.16[c]
2005	17	28.78±1.32[bc]	37.44±1.36[c]
2006	15	31.41±1.49[ab]	41.92±1.49[ab]
2007	20	33.13±1.26[ab]	42.56±1.31[ab]
2008	13	36.42±1.56[a]	45.66±1.60[a]
2009	18	34.57±1.37[ab]	44.19±1.39[a]
2010	12	35.99±1.72[a]	44.15±1.64[ab]

N: number of records.
SE: standard error.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
* (P<0.001) and *** (P<0.001).
NS: non significant.

Long rainy season is followed by dry season, which can be challenging due to stress condition and less chance of getting natural pastures. Therefore AFC is affected by the chance for young cattle to be benefited from the this season.

The significant effect of year of birth on AFC reported in this study agreed with the reports of Iffa *et al.* (2006) and Menale *et al.* (2011) and it disagreed with Tadesse *et al.* (2006) in Ethiopia. The trend of AFC over year of birth was inconsistent (Figure 1). A decreasing trend of AFC observed in cows that were born from 2000-2004, but increasing trend of AFC observed in cows that were born from 2005-2010 (Figure 1). This might be due to management fluctuation among years and the recommended amount of energy were not fed for calves.

Days open (DO)

The overall least square mean and standard error for DO of Holstein Frisian and HF × Boran crossbred dairy cows was estimated to be 134.84 ± 3.51 days with coefficient of variation 54.58%. This is nearly comparable with the report of Denberga *et al.* (2009) and Lyimo *et al.* (2004) who found that the mean value for DO of 130 days in the urban smallholder dairy farms around Ziway and for smallholder crossbred dairy cows in sub humid costal Tanzania, respectively. But this result was lower than the mean DO of 185 days for crossbred dairy cows in central highlands of Ethiopia (Yohannes Shiferaw *et al.* 2003) and much lower than Iffa *et al.* (2006) who reported 200.13 ± 25.55 days for cross breeds in highland of Ethiopia. However, the DO in the current study is longer than 104 and 86 days reported for the smallholder crossbred dairy cows in Zimbabwe (Masama *et al.* 2003). The difference in the DO of crossbred cows in the current study might be attributed to the existing differences in management which have accounted for the observed differences on DO (Masama *et al.* 2003; Yohannes Shiferaw *et al.* 2003; Lyimo *et al.* 2004).

Results are given in Table 5. Year of calving and parity had significant effect (P<0.001) on DO, but the level of HF percentage and season of calving had no significant effect (P>0.05). Similar significant effect of year of calving was reported by Tadesse *et al.* (2010) for HF cows in Ethiopia. The highest and lowest value of DO observed during 2002 (173.53±9.90 days) and 2005 (103.45±10.34 days), respectively. Although there was no consistence trend, mean DO declined from 2002-2006, slightly increased in between 2007 and 2008 and remains constant with minimal decreasing trend from 2009-2014 (Figure 2). Generally, days open directly affect CI, which plays an important role in the profitability of dairy farm. Therefore, more emphasis should be given for the inconsistence trend of DO over year of calving.

Tadesse *et al.* (2010) reported similar finding regarding the effect of parity on DO. In contrast, reported non-significant effect of parity on DO of crossbreed dairy cows in highlands of Ethiopia. Cows in the 1st parity had significantly longer DO and remain constant in the other parities. The result reflected in this study agreement with Giday (2001) who reported that the longest DO in young cows, which might be due to lower energy balance as they are not able to consume more for their own growth, production, reproduction and maintenance, thus lower energy balance delays the onset of postpartum heat.

Calving interval (CI)

The overall least square mean and standard error for CI of pure Holstein Friesian and HF × Boran crossbred dairy cows was estimated to be 405.50 ± 3.32 days with coefficient of variation 16.9%. The result is comparable with 408 days for crossbred dairy cows of urban smallholder dairy farms reported by Denberga *et al.* (2009). However, it was lower than the CI of 459 ± 2.4 days for HF crosses in central highlands of Ethiopia (Tadesse, 2001) and 552 days for crossbred dairy cows in central highlands of Ethiopia (Yohannes Shiferaw *et al.* 2003).

However, the CI in the present study is longer than the generally accepted calving interval of 365 days expected on a commercial dairy farm. This longer CI is the result of longer DO obtained which could be related to poor management of the existing farm including poor breeding management. Belay *et al.* (2012) suggested that relatively longer CI might be indicative of poor nutritional status, poor breeding management, lack of own bull and artificial insemination service, longer days open, diseases and poor management practices.

Results are summarized in Table 5. Year of calving and parity had significant (P<0.001) effect, but the level of HF percentage and season of calving (P>0.05) had no significant effect. The observed significant effect of year of calving is in line with the findings of various reports (Tadesse, 2006; Tadesse *et al.* 2010; Menale *et al.* 2011) in Ethiopia. The highest calving interval was recorded during 2002, whereas during 2005, 2006 and 2014, respectively, recorded lowest calving interval. Calving interval for cows that were calved from 2002-2006 decreased and remains constant from 2007-2012 and decreased then after. In general, the trend of CI over year of calving was inconsistence (Figure 2).

This inconsistent trend might be attributed to change in climatic condition, negligence of management practice, because these years were the period of regime change and hence directed to financial scarcity as the farm was funded by government across year of calving.

Table 5 Least square means (LSM±SE) of calving interval (CI), days open (DO) and number of service per conception (NSC) of Holstein Friesian and HF × Boran crossbred dairy cows over the fixed effects of level of cross-breed percentage, season of calving, year of calving and parity

Factor	CI (days)		DO (days)		NSC	
	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE
Overall	700	405.50±3.32	691	134.84±3.51	809	1.36±0.03
Level of cross-breed		NS		NS		NS
¾ Friesian × ¼ Boran	275	397.13±5.19	255	128.99±5.99	284	1.42±0.04
$^{7}/_{8}$ Friesian × $^{1}/_{8}$ Boran	295	406.33±4.55	290	135.96±4.94	338	1.37±0.04
Holstein Friesian	130	413.04±7.31	146	139.58±7.91	187	1.30±0.06
Season of calving		NS		NS		NS
Long rainy	244	396.87±5.06	237	124.78±5.40	278	1.41±0.04
Short rainy	217	412.89±5.08	219	140.30±5.52	277	1.33±0.04
Dry season	239	406.74±5.01	235	139.45±5.56	254	1.35±0.04
Year of calving		***		***		***
2002	93	437.08±8.83^{a}	94	173.53±9.90^{a}	97	1.64±0.08^{a}
2003	29	409.95±13.45^{cab}	27	129.48±15.40^{cab}	29	1.20±0.12^{bcd}
2004	43	389.61±11.61^{cb}	42	109.07±12.98^{cb}	46	1.51±0.10^{ab}
2005	65	382.52±9.46^{c}	66	103.45±10.34^{c}	70	1.58±0.08^{ab}
2006	67	376.78±9.22^{c}	63	111.18±10.43^{cb}	74	1.50±0.08^{ab}
2007	67	427.37±9.03^{cab}	63	154.31±10.16^{cab}	81	1.32±0.07^{cd}
2008	57	429.35±9.49^{ab}	55	162.58±10.61^{ab}	60	1.27±0.08^{cd}
2009	59	413.10±9.20^{cab}	60	136.45±10.11^{cab}	70	1.31±0.08^{cd}
2010	53	406.30±9.72^{cab}	50	129.21±11.05^{cab}	63	1.12±0.08^{e}
2011	51	415.06±10.03^{cab}	34	135.37±13.49^{cab}	56	1.21±0.09^{cd}
2012	54	428.28±9.65^{cab}	48	154.55±11.37^{cab}	52	1.27±0.09^{cd}
2013	48	398.36±10.39^{cab}	48	129.47±11.56^{cab}	56	1.29±0.09^{cd}
2014	14	357.74±19.04^{c}	41	124.32±12.42^{cab}	55	1.48±0.09^{ab}
Parity		***		***		NS
1	161	441.22±5.89^{a}	162	178.01±6.40^{a}	200	1.42±0.05
2	145	410.11±6.13^{b}	145	133.57±6.64^{b}	155	1.34±0.05
3	116	394.98±6.74^{b}	114	117.49±7.45^{b}	132	1.35±0.06
4	86	399.89±7.80^{b}	86	129.12±8.68^{b}	105	1.29±0.06
5	69	395.38±8.78^{b}	67	126.29±9.82^{b}	73	1.33±0.08
6	54	401.96±10.07^{b}	51	130.24±11.24^{b}	58	1.33±0.09
7^{+}	69	394.97±9.25^{b}	66	129.18±10.20^{b}	86	1.47±0.07

N: number of records.
SE: standard error.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
*** (P<0.001).
NS: non significant.

The significant effect of parity on CI of Holstein Friesian and HF × Boran crossbred dairy cows is in agreement with the report of several authors (Tadesse and Dessie, 2003; Goshu *et al*. 2007; Mekuriaw *et al*. 2009; Tadesse *et al*. 2010; Menale *et al*. 2011). On contrary to the current finding, Mulindwa *et al*. (2006) in Uganda found that parity did not significantly (P>0.05) affect CI. Cows with first parity recorded highest CI. The evidence from longer DO recorded in first parity of animal was the result of longer CI in 1st parity of this study.

Number of service per conception (NSC)

The overall mean and standard error of NSC of Holstein Friesian and HF × Boran crossbred dairy cows found in this study was estimated to be 1.36 ± 0.03 with coefficient of variation 44.9%.

This is nearly comparable with Moges (2012) who reported that services required for each conception was 1.3, 1.5 in urban and peri urban areas in Gonder, respectively. It was higher than 1.29 (Ibrahim *et al*. 2011) for local × Holstein in Gondar, Ethiopia.

However, the result observed was lower than 1.72 for Boran and its crosses at Holetta research center (Tessema *et al*. 2003) and 1.720 ± 0.06 for smallholder crossbreed cows in Ziway (Goshu *et al*. 2007). The NSC found in the study area suggests comparatively better result in Ethiopian conditions.

This might be due to semen quality, use of reproductive technology, heat detection ability and individual skill difference of AI technicians. Furthermore, favorable environmental condition in the study area makes more animals to have first service.

The results are summarized in Table 5. Number of service per conception was significantly affected by year of calving ($P<0.001$) only, but level of HF percentage, season of calving and parity had no significant effect ($P>0.05$). The non-significant effect of season of calving, blood level and parity in the current study disagreed with Asimwe and Kifaro (2007) and Ahmed *et al.* (2007). But Goshu *et al.* (2007); Tadesse *et al.* (2010) and Hammoud *et al.* (2010) reported non- significant effect of season on HF cows in Ethiopia and Egypt, respectively.

Non-significant effect of parity on NSC was reported by Ibrahim *et al.* (2011), while Goshu *et al.* (2007) and Yifat Denbarga *et al.* (2009) found significant effect of parity on NSC.

Number of service per conception of animals were highest during the year 2002 and 2005, whereas lowest in animals that were calved in 2010. Generally NSC observed in the current study showed a progressively decreasing trend from 2002-2010 except 2003, which is significantly decreased and again increased from 2011-2014 (Figure 3).

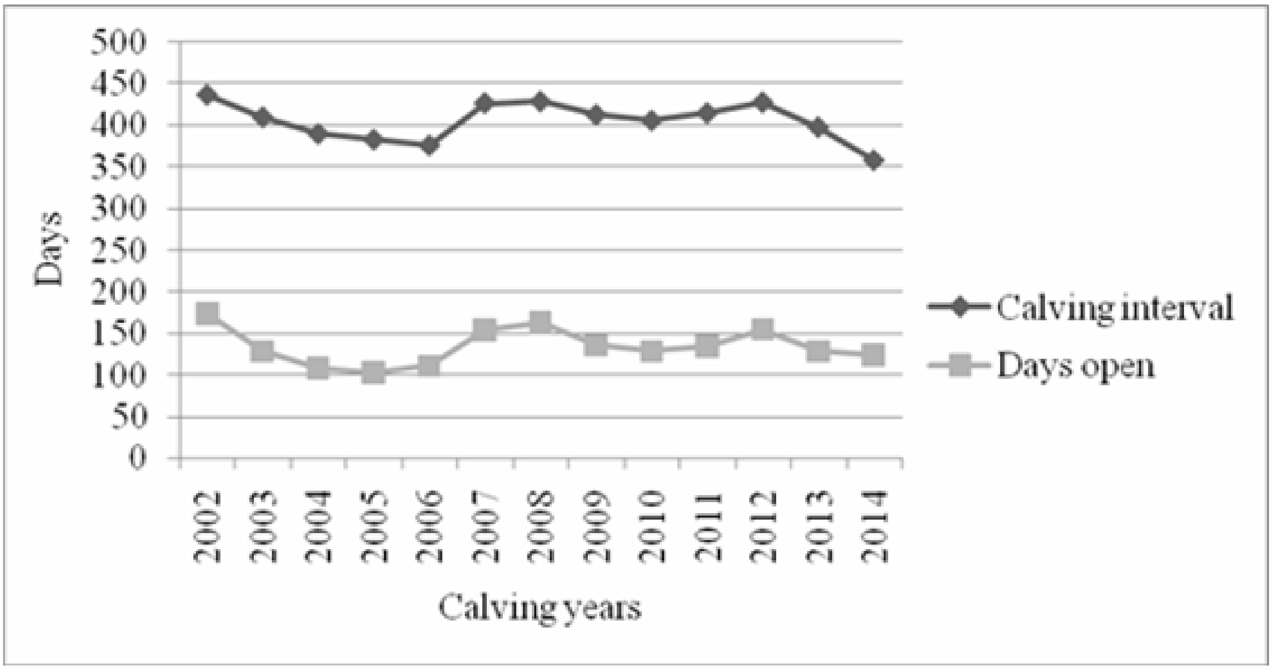

Figure 2 The trend of calving interval and days open over year of calving at Ardaita College

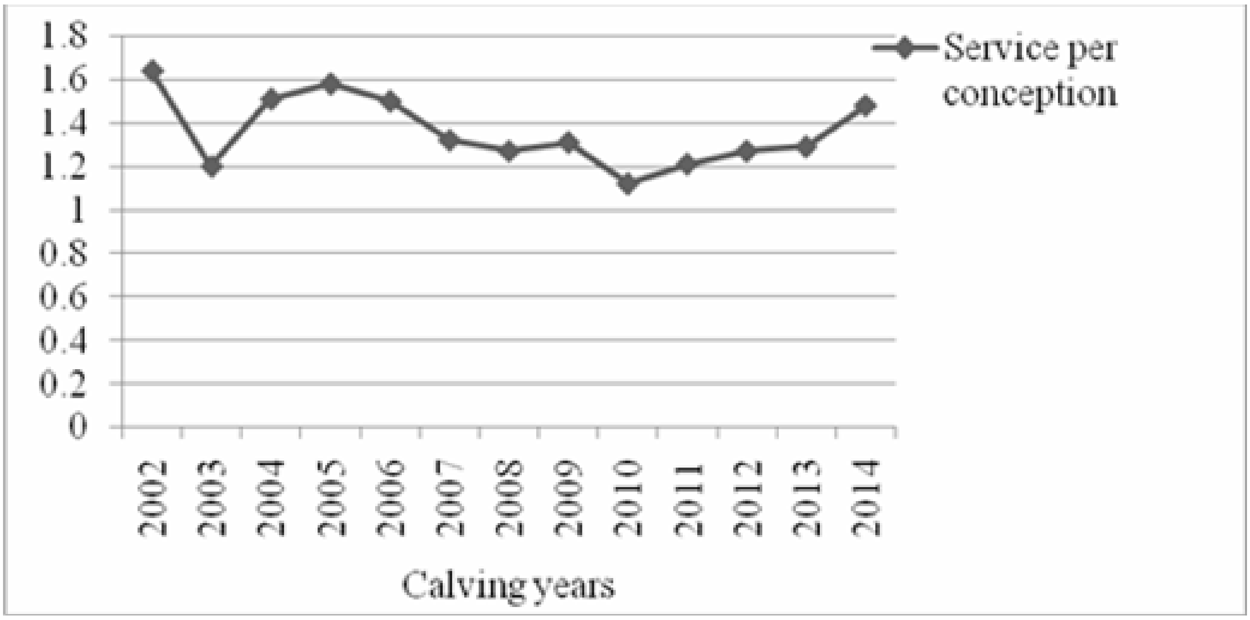

Figure 3 The trend of number of service per conception over year of calving at Ardaita College

The decreasing trend over the years could reflect change of management regime like adequate feeding, difference in inseminators, proper heat detection, artificial insemination (AI) service and semen quality over the years.

CONCLUSION

The mean obtained for NSC was generally good as compared to other studies. AFS, AFC, CI and DO of Holstein Friesian and HF × Boran crossbred dairy cows in the study area were not satisfactory and below the standard expected from commercial dairy farm. Animals with 100% HF had longer AFS than 75% and 87.5% HF percentage, respectively. This could be due to inability of higher graded cows to withstand the prevailing environmental and management condition. Season of birth ($P<0.05$) and year of birth ($P<0.001$) significantly influenced AFS and AFC. The traits CI and DO significantly ($P<0.001$) influenced by year of calving and parity. Except AFS the effect of level of HF percentage was not significant ($P>0.05$) on all reproductive traits. NSC was influenced by year of calving only. Due to this level of management and breeding practice, management difference, variation of climatic condition over season of birth, year of birth and year of calving might be accounted for the lower value of reproductive traits in the study. The result therefore would provide very useful information and assist decision making particularly regarding how to improve the low reproductive performance for future production. The longer DO and CI in this study resulted to have very limited number of calve delivered in its life time. It is recommended that, adequate plane of nutrition before and after calving, good breeding management and keeping the health condition of animals in the farm will help to increase the onset of cycling activity in the breeding season and help to minimize the longer DO and CI. Since year of calving and year of births had shown to influence the performance of the existing breed, great attention should be given for the inconsistent management practice across the years.

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