Lifetime Performance of Pure Jersey Dairy Cattle in the Central Highlands of Ethiopia

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Abstract

The ability of the cows to produce and reproduce for many years is a desirable characteristic. The aim of this study was to evaluate lifetime performance of pure Jersey dairy cattle at Adea Berga Dairy Research Center in the central highlands of Ethiopia. The General linear model (SAS ver. 9) was used to estimate the effect of fixed factors. Overall 3015 productive and reproductive performance records were used. The results of general linear model revealed that lactation milk yield and lactation length were significantly affected by year and parity (P<0.001). However, calving season did not have significant influence on lactation milk (P>0.05). The overall mean herd life of pure Jersey in the present study was 1813.76± 40.18 days (4.97 years). The least square mean of calf crop was 3 and 20 percent of the pregnancies were lost either by abortion or still birth. The least square mean of lactation milk yield and lifetime milk yield were 2155 kg (in 336 days lactation length) and 7216 kg, respectively. The results indicate that Jersey cows under the particular management of Adea Berga farm produced reasonable amounts of milk and length of herd life was high. Data and results of this study can provide the basis for improvement on farm selection of cows and young bulls for the national artificial insemination center (NAIC).

Keywords: herd life, lifetime milk yield, cattle, Jersey, Ethiopia

Introduction

In Ethiopia, the genetic improvement of dairy cattle is mainly based on cross breeding and adoption of improved exotic breeds. Even though there is a concern about adaptation of pure exotic dairy cattle to tropical environment (climate, feed and disease challenge), pure Friesian and Jersey dairy breeds have been raised by large scale private and state dairy farms in Ethiopia. Improved exotic breed would potentially serve selected niches in milk supply and have been also used as a genetic pool for the national artificial insemination center (NAIC) to recruit AI bulls

for genetic improvement program in the country. Million and Tadelle (2003) reported 3183 kg milk yield in 362 days lactation length for Holstein Friesian cows in Debrezeit area of Ethiopia.

However, there is limited information on performance of pure Jersey breed in Ethiopia. Research reports in the tropics revealed that Jersey cows are characterized by small body size, hardy and adaptable, low maintenance requirement, high feed conversion efficiency, high milk fat content, and good reproductive performance and has been selected for tropical research and development programs (Njubi*et al*., 1992; Cunningham and Syrstad, 1987). Thus they could be a good alternative in Ethiopian highland environment to use as an additional option for intensive and large scale dairy farms as well as genetic pool for genetic improvement activities. Having information on performance of pure Jersey cows in Ethiopia will help to suggest the future genetic improvement options for this herd as it is being managed as a bull dam station and dairy research farm. The aim of this study was therefore to evaluate the lifetime performance of pure Jersey dairy cattle at Adea Berga Dairy Research Center in the central highlands of Ethiopia.

Materials and Methods

Description of the study area

This study was conducted at Adea Berga Dairy Research Center in West Shewa Zone of Oromia Regional State of Ethiopia. Adea Berga wet land is situated in the central highlands of Ethiopia at 9^0 16، N latitude and 38^0 23، E longitude, 70 km West of Addis Ababa and 35 km North West of Holetta on the main road to Muger. It lies at an altitude of 2500 meter above sea level. It is characterized by cool sub-tropical climate with the mean annual temperature and rainfall of 18^0C and 1225 mm, respectively (HARC, 2010). The vegetation is mainly composed of perennial grasses and sedges. Clovers, Pennisetum and Andropogon are the most common species dominating the pasture in the area.

Description of the farm and data sources

Adea Berga Dairy Farm was established at Adea Berga wetland in 1986 for commercial milk production under government state farms by using 400 introduced pure Jersey pregnant heifers and two sires (foundation stock) from Denmark. The farm had been engaged in the production and rearing of pure Jersey breed from imported foundation stock for milk production by the dairy development enterprise and also serving as a bull dam station for the National Artificial Insemination Center (NAIC). Then it was transferred to Holetta Agricultural Research Center for genetic improvement research program since 2007.

The data for this study was obtained from long-term records of pure Jersey breed that has been kept for dairy production in the farm. Recorded data for the last 24 years (1986-2010) on production and reproduction were used for this study.

Herd management

Herds are managed separately based on sex, age, pregnancy and lactation. Calves were allowed to suckle their dam until 5 days to obtain sufficient colostrum and then separated from their dams and offered fresh milk twice a day for about 6 months. Cows and heifers were allowed to graze

natural pasture for about 4 hours a day and supplemented with hay and concentrate feeds up on return to barn during dry and small rainy season. However, all animals were restricted from grazing and managed indoor during main rainy season. There was regular over flood of river in the pasture land as a result of heavy rains during this period and the farm has a regular plan to harvest and stock up hay for dry and short rainy season supplementation. Calves less than 6 months, bulls and late pregnant cows and heifers were usually isolated and managed indoor.

All animals were supplemented with hay and concentrate feeds. The concentrate was usually composed of 60% wheat bran (sometimes with wheat middling), 38% noug seed cake (*Guizotia abyssinica*) and 2% salt. The amount consumed is not exactly known, since it depends up on the amount of feed available on stock. Milking was done twice a day at equal interval and the milk produced by each cow was measured and recorded on prepared format immediately after milking. Routine vaccination was conducted against Blackleg, Anthrax, Pasteurellosis, Foot and mouth disease (FMD) and Lumpy Skin Disease. Animals were de-wormed against internal parasites and treated against other infectious diseases by tentative diagnosis.

Breeding program

Pure breeding program was carried out starting on imported foundation stock of 400 pregnant heifers and two sires. Controlled mating program was practiced using both natural mating and artificial insemination. Mating was continuous and practiced throughout the year. NAIC rarely introduce new exotic Jersey semen since this farm has been used as a bull dam station for semen production to dispatch Jersey semen for national crossbreeding activities. Thus, very few young bulls were recruited based on dam performance and physical conformation for NAIC semen collection and on station breeding activities through natural mating. The rest of the male calves were culled from the farm at an early age. The mating date and sire identification number were recorded on herd book for every insemination and then transferred to cow›s individual card.

Data analysis

A retrospective type of study was conducted to evaluate lifetime performances of the cows. Data was categorized into disposed cattle record to evaluate lifetime traits and pooled records (available herd and disposed) to estimate their productive performance. General linear model (GLM) least square for quantitative trait and chi square tests for qualitative trait were used to analyze the fixed effects (SAS version 9, 2002). The fixed effects fitted were animal group (imported and farm bred; farm bred animals were the progeny of imported animal that were raised in the farm), year period (grouped in to 5-7 classes based on birth and calving years. each year period represent three years), season; grouped in to three classes, based on pattern of annual rain fall distribution as dry period (October to February), light rain (March to May) and main rain (June to September), Parity (grouped in to eight classes 1,2,3,4,5,6,7and 8+).Lactation records of eighth and above parities were pooled. Preliminary analysis showed that interaction effects of the fixed factors were not significant and thus not included in the model. The statistical model is described as follows:

Experimental Models

1. Lactation milk yield and lactation length
   $Y_{ijkl} = \mu + Y_i + C_j + S_k + P_l + e_{ijkl}$
   Where, $Y_{ijkl}$is milk yield and lactation length trait;
   μ is the overall mean; Y_i is the fixed effect of i^{th}year period of birth; $C_j$is the fixed effect of j^{th}year period of calving;
   $S_k$is the effect of k^{th} season of calving;
   P_l is the effect of l^{th}cow parity;
   $e_{ijkl}$is random residual term.

2. Lifetime traits (Herd life, lifetime milk yield, calf crop)
   $Y_{ijk} = \mu + Y_i + S_j + G_k + e_{ijk}$
   Where, Y_{ijk} is the life time traits; μ is the overall mean; Y_i is the fixed effect of i^{th}year period of birth; S_j is the fixed effect of j^{th} season of birth; G_k is the fixed effect of k^{th}animal group; e_{ijk} is random residual term.

Results and Discussion

Lactation milk yield (MY)

Increasing milk production is the ultimate goal of dairy sectors to attain milk self sufficiency and to maximize the profitability of dairy industry. Thus, most genetic improvement programs of developing countries have focused on improving production performance of dairy cattle. Results of the least squares means and standard errors for fixed effects of birth year period, calving year period, calving season and parity are summarized in Table 1. The overall lactation milk yield and lactation length of pure Jersey cows were found to be 2154.99± 16.40 kg and 336.17± 2.35days, respectively.

The result obtained in this study (2154.99 kg) similar to the reports of Yosef (2006) and Lateef *et al.* (2008). They found lactation milk yields of 2200 and 2229 kg for Jersey cattle in Ethiopia and Pakistan respectively. On the other hand, Njubi *et al*. (1992) reported a milk yield ranging from 1257kg to 1788kg for Jersey cattle per lactation which was lower than the figure obtained in the current study. The result of this study is lower than the finding of Borland and Moyo (1996) who found 3504 to 5141 kg lactation milk yield in Zimbabwe. This might be due to difference in climate and animal management.

Calving year period and parity had significant effect on MY ($p<0.0001$), but birth year period and calving season did not have significant effect ($p>0.05$). Trend of lactation milk yield associated with period of calving had no clear pattern. This could be attributed to the inconsistent management practices across years and cows were not fed according to recommended amount. However, some progressively increasing trend observed in lactation milk yield over the period of calving is an indicative of improved management and adaptation of this breed to the prevailing environment through time. Low performance of cows which calved in between 1991 and 1993 could be related to financial problems of the farm to avail sufficient feed due to regime change as this farm was funded by government. The pregnant heifers imported for foundation stock gave

their first calf in between 1988 and 1990 and their milk yield was lower as compared to other calving period. This might be attributed to adaptation problem as the animals were exposed to new environment which could create more difficulty to express their genetic potential. Sendros *et al*. (2004) noted that year and parity had significant effects on lactation milk yield of crossbred cows in Holetta station, Ethiopia which agrees with the present finding. Similarly, reports from Kenya showed that mean milk yield performance of Jersey breed declined from 2,200kg in the 1960s to about 1500 kg in the 1980s (Njubi *et al*., 1992).

Analysis of variance of this study revealed that lactation milk yield significantly differed among parities ($p<0.0001$). Lactation milk yield seems linearly increasing from 1^{st} to 5^{th} parity. But Milk yield recorded at 2^{nd} parity was greater than that of 3^{rd} parity which is contradictory with several literatures. This could be due to lactation stress of first and second lactation. The lactation milk showed a declining trend after the 5^{th} parity. Similar observations were reported by several authors (Million *et al*., 2004; Yosef, 2006, Lateef, 2007; Njubi*et al*., 1992; Million *et al*., 2010). Amimo *et al*. (2007) and Amani *et al*. (2007) also found that Ayrshire and Friesian cows attained their peak milk yields at the 4^{th} parity. Season of calving did not have a significant effect on lactation milk yield in the present study.

Herd life

Herd life refers to the period from first calving to culling of a cow from the herd. The ability of the cows to produce and reproduce for many years is a desirable characteristic. Longer herd life maximizes profit for producers as it creates more opportunity for additional herd replacements if the farms need expansion otherwise reduce the cost of replacements and more milk production over an extended period of time.

The overall mean herd life (HL) of pure Jersey in the present study was 1813.76± 40.18 days (4.97 years). The value of this study is similar to the figure reported for Holstein cows (5 years) in Slovenian(Jan**ž**ekovi**č***et al*., 2009), but higher than the value reported for Simmental cows (4 years) in Croatia (Sonja and Nikola, 2011) and Slovak(Strapák et al., 2011).However, the result of the present study is lower than 6 years reported for Holstein and 8 year for Jersey in Pakistan (Teodoro and Madalena, 2005**),** 6 years for crossbred in Ethiopia (Gebregziabher and Mulugeta, 2006) and 7 years for 75 % European inheritance crossbred in Ethiopia (Kefena et al., 2004). The difference in HL observed in the present study as compared to the estimate of several literatures could be due to environmental difference in which the cows were maintained. Birth year, birth season and animal group did not have significant effect on HL (Table 2)

Table1. Least square means and standard error of milk yield and lactation length for fixed effects of birth year group, calving year group, calving season and parity

Effect	N	Variable	
		Milk Yield (kg)	Lactation length (days)
overall	2658	2154.99± 16.40	336.17±2.35
Birth year group		NS	***
1985-1987	1193	2240.53±85.55	353.45±12.28 [a]
1988-1990	266	2184.90±73.23	331.94±10.51 [b]
1991-1993	168	1994.84±74.69	314.08±10.72 [b]
1994-1996	362	2143.33±63.52	312.24±9.12 [b]
1997-1999	335	2099.71±86.25	327.56±12.38 [ab]
2000-2002	189	1977.71±133.5	326.31±19.17 [ab]
2003-2005	145	1872.04±169.5	355.86±24.33 [ab]
calving year group		****	****
1988-1990	751	1759.19±166.20 [d]	275.15±23.86 [c]
1991-1993	374	1395.22±138.10 [e]	337.05±19.83 [ab]
1994-1996	301	2253.34±111.84 [ab]	348.42± 16.06 [ad]
1997-1999	327	1995.64±79.21 [cd]	318.71± 11.37 [be]
2000-2002	344	2212.04±59.07 [b]	319.59± 8.48 [bcd]
2003-2005	291	2526.09±64.35 [a]	331.69± 9.23 [ab]
2006-2008	223	2229.06±94.89 [bc]	355.60± 13.62 [ae]
2009-2010	47	2215.77±155.22 [bcd]	366.87± 22.28 [ab]
Calving season		NS	NS
Dry	1380	2101.30±46.89	329.71±6.73
Short rain	595	2066.49±54.41	333.70±7.81
Main rain	683	2052.07±50.6	331.47±7.26
Parity		****	****
1	803	2066.61± 41.21[b]	354.46±5.92 [a]
2	649	2362.63± 41.09[a]	355.24±5.90 [a]
3	442	2073.02± 47.34[b]	323.11±6.80 [b]
4	309	2262.08± 57.72[a]	349.85±8.29 [a]
5	190	2302.98± 75.85[a]	350.00±10.89 [a]
6	127	2005.48± 94.25[b]	314.15±13.53 [bc]
7	73	1985.88± 125.2[b]	323.99±17.97 [ab]
8	65	1527.66± 141.1[c]	282.28±20.26 [c]
CV		39.24	36.11

N= Number of observation, **** =p< 0.0001 ***= p< 0.001 NS (not significant) = p> 0.05 Least squares means with same superscript in the same fixed effect indicate non significance.

Lifetime milk yield (LTMY)

Table 2 shows the lifetime milk production performance of Jersey cows. The overall least square mean lifetime milk yield was found to be 7216.34 ± 189.83kg in 2670.97± 40.21 days، total life (1813.76± 40.18 days herd life). The LTMY noted in the present study is higher than the value reported for Friesian (6021kg) and Jersey cattle (3699kg) in Pakistan (Lateef, 2007). Sreemannarayana *et al*. (1996) also estimated lower lifetime milk yield for Ongole (4567kg) and Jersey x Ongole crossbred cows (6372kg). The value obtained in this study is also higher than the report of Aynalem *et al*., (2011) who found 6309 kg for 62.55% exotic cross, 7122 kg for 75% exotic cross and 5820 kg for 87.5%exotic cross in Ethiopia. On the contrary it is lower than 11912 kg for Friesian cows which kept under high level management in Venezuela (Rizzi *et al*., 2002) and 7998 kg for 50% F_1 crossbred in Ethiopia (Aynalem *et al*., 2011). These indicated that the performance of Jersey cows was comparable with crossbred cows in the tropical environment. However, the lower LTMY of Jersey cows observed in the present study as compared to European counterpart probably indicated that the management level, in which this temperate breed had been kept, was not sufficiently supporting the cows to express their genetic potential. Similarly it can be noted that less effort has been done in the last years to improve their genetic potential.

Lifetime calf crop

The overall least square mean and standard error of lifetime calf crop of pure Jersey cows in the present study was 3.22±0.07. The result is closer to the value (3.5) reported for Boran and Boran x Friesian crossbred (Gebregziabher and Mulugeta, 2006) and 3.6 reported for synthetic dairy cow in Alberta, Canada (Arthur *et al*., 1993). But it is lower than the value (5.2) reported for pure Horo, and 4.5 reported for Horo x Simmental crossbred in Bako research station in Ethiopia (Gebregziabher and Mulugeta, 2006). The lower estimate of calf crop in the present study was probably due to higher abortion and still birth (20.08%) incidence in the farm. The result of present study revealed that calf crop was significantly affected by birth year period and birth season ($p< 0.05$). However, animal group did not have significant effect on calf crop ($p>0.05$).

Abortion and still birth

Abortion refers to loss of fetus at less than 260 days of gestation. Whereas calf that born dead between 260 days and full term is considered as stillbirth. A full term delivery or completed gestation is considered as normal delivery. The overall frequencies of normal delivery, abortion and still birth are 79.93%, 13.20% and 6.88%, respectively. Generally the result of the present study revealed that 20 percent of the pregnancies were lost either by abortion or still birth. The frequency of abortion recorded for Jersey cattle in this study is substantially higher than 3 to 5% which is considered tolerable in dairy farms (Kirk, 2003; Hovingh, 2009). Sreemannarayana *et al*. (1996) also reported 6.4% and 7.3%incidence rate of abortion in Ongolo and crossbreds, respectively which is also lower than the current finding. On the contrary frequency of abortion

(13.20%) recorded in this study is similar with the value (13.60%) reported for Boran cows at Abernosa ranch in Ethiopia (Ababu, 2002). However, it is lower than 17.6% reported for Boran x Friesian herd maintained at Chefa state farm in Ethiopia (Gebeyehu and Hegde, 2003).

Table2. Least square mean and standard error of herd life and lifetime milk yield

Effect	N	Variable	
		Mean ± SE HL (days)	Mean ± SE LTMY (kg)
Overall	680	1813.76±40.18	7216.34±189.83
Birth season		NS	NS
Dry	422	2017.32 ± 318.64	7211.89 ± 1505.26
Short rain	82	2069.58 ± 338.12	7352.89 ± 1597.30
Main rain	176	2164.53 ± 327.38	8251.95 ± 1546.54
Birth year period		NS	***
1985-1987	369	1426.63 ± 530.25	7144.07 ± 2504.91 [ab]
1988-1990	91	2173.30 ± 541.79	5856.17 ± 2559.45 [b]
1991-1993	41	2326.93 ± 553.26	8111.77 ± 2613.60 [a]
1994-1996	96	2175.43 ± 540.06	8048.88 ± 2551.25[a]
1997-1999	83	2316.76 ± 528.33	8867.00 ± 2495.85 [a]
Animal group		NS	NS
Imported	370	2544.54 ± 844.67	7103.87 ± 3990.22
Farm bred	310	1623.08 ± 220.12	8107.29 ± 1039.86
CV		57.77	68.60

N= number of observation, **** =p< 0.0001 ***= p<0.001 * = p< 0.05, NS (not significant) =p>0.05)

Least squares means with same superscript in the same fixed effect indicate non significance.

Conclusion and Recommendation

The overall results indicate that Jersey cows under the particular management of Adea Berga farm produced reasonable amounts of milk and had longer herd life. It was noted that the significant effects of years and seasons indicate inconsistent management across the years and seasons. Data and results of this study can provide the basis for improvement on farm selection of cows and young bulls for the national artificial insemination center (NAIC).The need of feeding and animal health intervention is essential to reduce the environmental stress. Since the

farm is being used as genetic pool to recruit bulls for crossbreeding activities, better breeding schemes should be designed for further improvement of performances.

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