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Productive and Reproductive Performance of Jersey Cattle in the Hill Country of Sri Lanka

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Abstract: The objective of this study was to evaluate the productive and reproductive performance of Jersey cattle in the National Livestock Development Board farm Dayagama, Sri Lanka. The records on productive traits viz. lactation milk yield, birth weight, lactation length and calving interval and reproductive traits viz. age at first calving, number of service per conception, calving to service period, days open, gestation length and dry period were collected from 131 Jersey cows in the farm for the period of 1999 - 2011. The data were analyzed using SAS (Version 8.0). The overall least squares means of lactation milk yield, lactation length, birth weight and calving interval were 2235±776Kg, 323.78±91.02days, 20.97±2.35kg and 447.73±142.88 days, respectively. The overall means of age at first calving, calving to service period, days open, gestation length and dry period were 41±10 months, 92±66 days, 156±123 days, 276±12 days and 120±122 days, respectively. The number of services per conception, rate of abortion and still birth were 2.1±1.29, 3.96% and 5.4%, respectively. The study reveals that the values for total milk yield, birth weight, lactation length and number of services per conception falls within the average values observed in other tropical countries. However values for calving interval, age at first calving, calving to service period and days open were higher than the optimum values recommended to maintain reproductive efficiency. It could be concluded that the factors influencing each trait identified in the current study could be used to improve the performance of Jersey cattle in Dayagama farm.

Key words: Jersey Cattle · Calving · Reproduction · Lactation · Milk Yield

INTRODUCTION

Dairy sector has been indicated as one of the important sector among other livestock sub sectors in Sri Lanka. The domestic milk production in year 2014 was 333.9 million liters and out of which 273 million liters of milk was from cows [1]. Temperate cattle breeds have been chosen and introduced in tropical region of the world in order to increase the milk production and satisfy demand for milk and milk products, because the indigenous cattle are poor milk producers [2]. The dairy industry has potential to contribute considerably to Sri Lanka's economic development. A traditional industry surviving thousands of years, milk production also plays an important role in alleviating nutritional poverty in all age groups. And it is a source of extensive employment opportunities. The government from the time of independence has recognized the importance of the dairy sector in the country and has taken various policy measures for its development [3]. The efficient reproduction is very important for productivity of dairy cattle and it is mainly depends on reproductive performance [4]. The milk production of dairy cattle also depends on genetic and environmental factors. Besides their genetic factors, the performance of dairy animals is affected by various environmental factors and these factors may suppress the true genetic abilities of those animals. It is very important to evaluate genetic composition of the particular animal before the breeding program. Evaluations on the production potential of imported exotic breeds in local conditions are necessary to improve the livestock industry in Sri Lanka [5].

The objectives of the current study was to evaluate the productive and reproductive performance of the Jersey cattle and the various factors affecting productive and reproductive performance of above breed at Dayagama farm in the hill country of Sri Lanka.

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MATERIALS AND METHODS

Study Area: Dayagama National Livestock Development Board farm is located within south western bank of the Horton plains in Nuwara-Eliya district of central province of Sri Lanka. The farm is located with an altitude 1676 meter above mean sea level and the soil of this region is red yellow latasol with low humid clay. The pH of the soil varies from 3.5 to 5.5 and the average rainfall of the farm is 1600mm for 200 to 250 rainy days. The monthly mean temperature is between 18°C to 28°C and the minimum temperature varies from 8° – 16°C. Night frost is common in February and March. Humidity is 75% to 85% and from May till September severe storm wind and misty weather can be expected.

Herd Management: Different types of pasture and fodder were cultivated in the farm. The pasture land consists Guinea A, Guinea B, Paspalam, Kikuyu grass, Pusa giant napier (PGN), *Bracheria milliformis*, White clover legume, CO_3 grass, Rye grass, Bana, Tropical Kudzu, Nandi, Italian rye and molasses grass. Green fodder was chaffed and given to the animals. Concentrates also were fed to the animals according to the needs. The concentrate mixture consisted maize, rice bran and coconut poonac, most of the needed vitamins were provided through mineral mixture.

Animals were maintained under semi intensive and intensive management. High yielding cows were maintained under intensive management system and low yielding cows were maintained under semi intensive management system throughout the year. All animals were grazed in the pastureland from 6.30am to 12noon and about one hour in the evening. Concentrate was given to the high yielding cows while heifers and dry cows were mainly kept on green fodder and other roughages. At the latter stage of pregnancy there was a special feeding system practiced called steam up and the pregnant animals were fed with high plane of nutrition with concentrates.

Breeding: Breeding was carried out mainly through artificial insemination however few sweeper bulls were used to cover the failures of artificial insemination and data belonged to both methods were included for analysis.

Data Collection: The data was collected over a period of thirteen years (1999 - 2011) from the NLDB farm, Dayagama. Originally 1450 records of 131 Jersey cows was obtained, unsuccessful date of services and lactation lengths with less than 90 days were deleted. After editing 556 records were used for analysis. Data on age at first calving (AFC), number of services per conception (SPC), calving to conception interval (DO), lactation length (LL), lactation number (LN), total milk yield (TMY) and birth weight (BW) were obtained from history sheets. Calving interval (CI), calving to service period (CSP), dry period (DP), gestation length (GL) were computed from calving date, service date and dry off dates. The dependent variables considered were AFC, SPC, GL, CI, CSP, DO, LL, DP and BW. Effects of genetic and various environmental factors on different dependent variables were studied.

The season of calving and season of dry off period were divided into two group viz. season 1 (December to February) and season 2 (March to November). The data on number of services per conception were split into two classes as follows: class 1 (Up to 2 services per conception), class 2 (More than 2 services per conception). The age at first calving was split into seven classes as follows: class 1 (Less than 27 months), class 2 (27-31 months), class 3 (32- 36months), class 4 (37-41months), class 5 (42- 46 months), class 6 (47-51 months) and class 7 (More than 57 months). Dry period was grouped into five classes; Class one comprised of cows which having dry period up to 30 days and subsequent classes were formed with an interval of 30 days while the fifth class comprised of cows having dry period over 120 days. Calving to service period was classified into six classes as follows: class 1 (Service period up to 39 days), class 2 (40- 50 days), class 3(51- 70 days), class 4(71- 90 days), class 5 (91- 110 days) and class 6 comprised of cows having service period over 110 days. Calving interval was grouped into 4 classes as follows: class 1 (Calving interval up to 365 days), class 2 (366- 395 days), class 3 (396- 450 days) and class 4 comprised of cows having calving interval greater than 450 days. Birth weight was grouped into three classes as follows: class 1 (Birth weight less than 20 kg), class 2 (20- 24 kg) and class 3 comprised cows which was having calf more than 24 kg. Lactation length was grouped into seven classes. Class 1 comprised of cows having lactation length less than 150 days and subsequent classes formed with an interval of 50 days while seventh class comprised of cows having lactation length greater than 400 days. Days open was classified into five classes, class 1 comprised cows which having calving to conception interval up to 50 days and subsequent classes were formed with an interval of 50 days while fifth class comprised days open greater than 300 days. Lactation numbers were grouped into 1 to 5 and 6^{th} group consisted lactation number 6 and above. Period was divided into three group; 2000- 2005 (Class 1), 2006-2008 (Class 2) and 2009- 2011(Class 3).

Statistical Analysis: Data were analyzed using Statistical Analysis System (SAS Version 8). General Linear Models were used to analyze the data and mean separation was done using LSD and Duncan Multiple Range test.

RESULTS

Productive Performance: Descriptive statics of productive performance of Jersey cows in response to various factors has been summarized in Table 1.

Milk Yield: The LS mean for milk yield was 2187.51 Kg per lactation. Milk yield was influenced by the traits year of calving (P<0.05), birth weight (P<0.05), lactation number (P<0.05), year of dry off (P<0.01) and lactation length (P<0.01) (Table 2).

As expected increase in milk yield with the advancement of lactation number was not observed. There was a reduction in milk yield during the dry off period of 2006 to 2008. In contrast to year of dry off the year of calving period of 2006 to 2008 gave the highest milk yield than the other two groups. There was a significant increase in milk yield for the lactation length of 250 to 300 days than the previous groups. Thereafter though there was a increase in milk yield with longer lactation lengths the differences were not substantial. Milk yield increased with the increase in birth weight.

Lactation Length: The overall least square mean for lactation length was 321.28 d. Lactation length was significantly influenced by calving to service period (P<0.01), days open (P<0.01) and dry period (P<0.01) (Table 3).

Birth Weight: The overall least square mean for birth weight was 20.68kg. The age at first calving (P<0.01), sex of calving (P<0.05) and year of dry off (P<0.01) had significant effect on birth weight.

Table 1: Descriptive statistics of different traits of Jersey cattle at Dayagama farm

Variable	N	Mean	SD	CV%
Services per conception	552	1.91	1.29	68%
Age at first calving (Mon)	536	41.94	10.51	25%
Calving to service period (d)	519	92.27	66.90	73%
Days open (d)	397	156.44	123.81	79%
Gestation length (d)	539	276.02	12.70	5%
Calving interval (d)	406	447.73	142.88	32%
Birth weight (Kg)	503	20.97	2.35	11%
Lactation number	525	2.96	1.81	61%
Lactation length (d)	440	323.78	91.02	28%
Dry period (d)	379	120.54	122.41	103%
Total milk yield (Kg)	438	2235.96	776.47	35%

N – Number of observations, SD – Standard Deviation, CV – coefficient of variation

Table 2: Effect of different traits on milk yield of Jersey cattle at Diagama farm

Class	No of observation	LS means for milk yield	Standard error	Class	No of observations	LS means for milk yield	Standard error
Lactation number				Year of dry off			
1	99	2196^{a}	142	1	51	2266^{a}	164
2	75	2103^{ab}	144	2	130	1950^{b}	134
3	47	2188^{a}	162	3	99	2321^{ac}	133
4	31	1823^{c}	165				
				Year of calving			
5	18	2110^{ab}	178	1	51	2066^{a}	151
6	10	2654^{cd}	236	2	117	2332^{b}	139
				3	112	2139^{ac}	139
Lactation length				Birth weight			
1	1	1493^{a}	637	1	83	1990^{a}	139
2	11	1647^{ab}	215	2	178	2181^{b}	134
3	16	1861^{bc}	185	3	19	2365^{b}	180
4	89	2252^{bcd}	110				
5	89	2472^{cd}	109				
6	39	2572^{cd}	144				
7	35	2957^{d}	147				

Means with same letters within a column do not differ significantly

Table 3: Effect of different traits on lactation length

Class	No. of observations	LS means	Standard error	Class	No. of observation	LS means	Standard error
Age at first calving				Calving to service period			
1	36	287[a]	14.8	1	24	319[a]	17.0
2	83	278[a]	10.6	2	42	302[a]	13.6
3	65	313[b]	12.0	3	72	330[b]	12.4
4	21	338[c]	16.8	4	37	344[bc]	14.5
5	27	380[cd]	15.8	5	29	356[cd]	15.8
6	17	405[d]	19.4	6	77	359[d]	11.5
7	32	344[bc]	16.2				

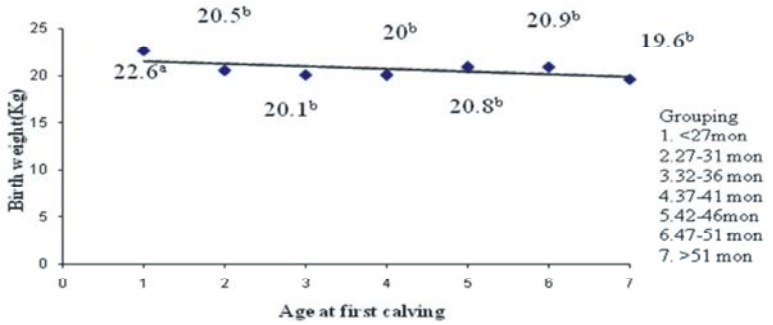

Fig. 1: Effect of age at first calving on birth weight

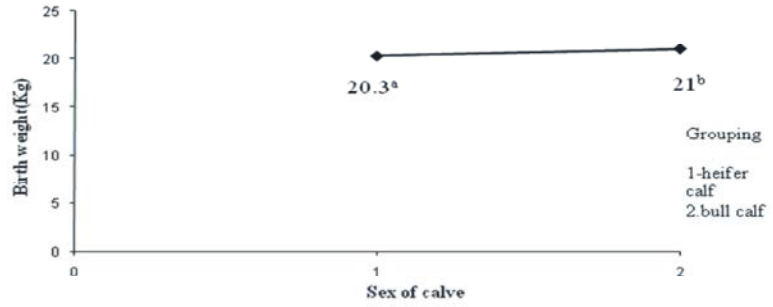

Fig. 2: Effect of sex of calve on birth weight

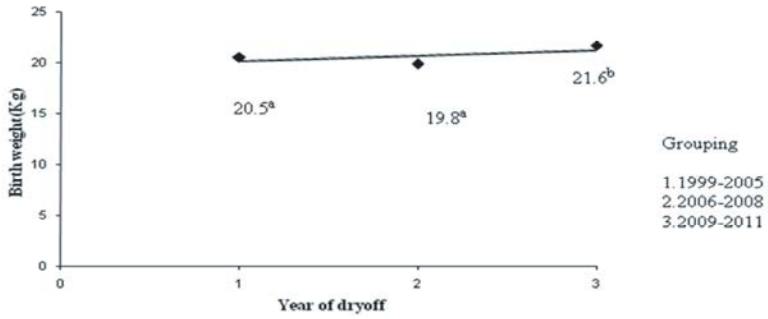

Fig. 3: Effect of year of dry off on birth weight

Effect of Age at First Calving on Birth Weight: The highest birth weight was observed when the age at first calving was less than or equal to 27 months. Thereafter, there was a reduction in birth weight with increase in age at first calving. However, the differences were not significant (Figure 1).

Effect of Sex of Calve on Birth Weight: Bull calves weighed heavier than female calves (Figure 2).

Effect of Year of Dry off on Birth Weight: Birth weight was lower for the dry periods of first two classes than the third class (Figure 3).

Calving Interval: In the present study the overall least square mean of calving interval was 431.41 days.

Reproductive Performance

Age at First Calving: Mean age at first calving was 41±10 months.

Calving to Service Period: The mean calving to service period was 92±66 days.

Days Open: The mean days open was 156±123 days.

Number of Services per Conception: In the present study the mean number of services per conception was 2.1±1.29.

Dry Period: The mean dry period was 120±122 days.

Gestation Length: Mean gestation length was 276±12 days.

Abortion and Still Births Rate of Calves: The overall rate of abortion and still birth for 10 years (From 2000-2010) out of 555 pregnancies were 3.96% and 5.4%, respectively.

DISCUSSION

Productive Performance: Higher coefficients of variation for descriptive statistics of productive traits suggest that there is potential for improvement of these traits through selection. The traits with higher variation were services per conception, calving to service period, days open and dry period. The variations could be mainly due to variations in feeding and improper culling programmes. High plane of nutrition and regular culling programmes might improve the studied traits and the overall performance of the herd.

Milk Yield: The milk yield observed in this study was 2187.51 kg per lactation in par with the values in the tropics (Range from 2141-2229 kg) reported by Lateef *et al.* [6], Rao *et al.* [7] and Bagherwal and Khan [8]. Javed *et al.* [9] reported that animals of temperate region maintained in tropical region may not perform equally because of the environmental variation.

The absence of increase in milk yield with the advancement of lactation number may be attributable to lapses in the management aspects specially feeding. These results were not in agreement with the findings of Javed *et al*. [9], Licitra *et al.* [10], Kemenes *et al*. [11] and Sattar *et al*. [12]. That indicates the milk yield of cow increased with the maturity of udder but when the cows becomes older milk production reduce and structure of udder may change because of fat deposition. However, maturity of udder greatly influenced by feeding and management practices of cows.

In the present study among three classes the highest milk yield was obtained for the class 2 which fell into the year of calving period of 2006 to 2008 but at the same time the lowest milk yield was coincided with the same dry off period which indicates the disparity in the management of dry animals. Tadesse and Dessie [13] reported that changes in climatic and other management condition change the milk yield of cow.

The significant effect of lactation length on milk yield was in agreement with the findings of Lateef *et al.* [6], Bagherwal *et al* [8], Javed *et al.* [9] and khan *et al.* [14]. Milk yield increased with increase in lactation length but there were animals with lactation length greater than 305 days which will decrease the overall reproductive efficiency by reducing the number of calf crops during the lifetime of the animal. Hence, attempts should be made to restrict the lactation length within 305 days.

Cows with high milk yield gave calves with higher birth weight. Dunklee *et al.* [15], also reported that well managed cows will produce healthy calves with higher body weight. So the cows which produced healthier and heavier calves produce high milk yield.

Lactation Length: The overall least square mean of lactation length (321.28 days) was almost similar to the values ranged from 314±61 to 321.7±2.26 days that reported by Rao and Rao [7], Kemenes *et al*. [11] Deshpande *et al.* [16] and Gogoi *et al*. [17]. Lower value of lactation length was reported by Javed *et al*. [9], Sattar *et al*. [12], Juneja *et al*. [18], Tesfaye and Alemu [19], Hasan [20] and Mondal *et al*. [21] and it ranged from 241 to 294 days. The shorter lactation length may be due to factors such as improper feeding practices, inadequate dry period and prevalence of disease. Lactation length of Jersey cows recorded in the present study was higher than value reported by Rao *et al*. [7], Ramachandraiah *et al*. [22] and Murdia and Tripathi [23]. However, lactation length greater than 305 days will hinder the optimum calving interval of 12 to 13 months. The higher least square mean for lactation length observed in the current study reflects that the cows were not dried off at the appropriate time and continued to milk for extended period.

Birth Weight: Least square mean of birth weight for Jersey calf in our study was 20.68 Kg. Almost similar values of birth weight were reported by Chaudhri *et al*. [24] and Bhuyan and Mishra [25] in India and Habatu *et al*. [26] for Jersey male calves in Ethiopia which ranged from 20.7-23.6 Kg. A higher value than the present study (26.76 kg) was reported by Campos *et al*. [27] in USA.

The highest birth weight for the age group less than or equal to 27months was an indication of better management to the heifers. Reduction in birth weight beyond 27 months is an indication of inadequate management to the heifers. The differences in birth weight with dry off period indicates the importance of the dry cow management and the differences are attributed for both climate change and management aspects.

Calving Interval: The mean calving interval of 431.41 days was similar to the value reported by Tadeese *et al*. [13], Ramachandraiah *et al*. [22], Kemenes *et al*. [11], Sreemannaryana and Rao [28], Niazi and Aleem [29] and Rath and Patro [30]. Lower mean calving interval was reported by Campos *et al*. [27] in USA and Rao *et al.* [7] in India. While higher mean value of calving interval than present study was reported by Ganpule *et al*. [31] in India and Adeneye [32] in Nigeria. The longer calving interval than the optimum length of 12 to 13 months may be as a result of longer calving to service period and days open of the current study. In addition environmental factors, poor reproductive managements such as inaccurate heat detection, untimely insemination and inefficiency of AI technicians and inadequate and low quality feed supply could be the possible causes for long calving intervals.

Age at First Calving: The average age at first calving 41.94 months was higher than the value reported by Sattar *et al.* [12], Haq *et al.* [33], Baruah *et al*. [34] and Govindaiah *et al*. [35] in the tropics. Similar age at first calving was reported by Habtamu *et al.* [26] in Ethiopia. The prolonged age at first calving of Jersey cows in our study compared to literature results could be attributed to factors such as poor nutrition and management practices including poor heat detection at the time of mating the heifers. With good nutrition it is expected that heifers would exhibit fast growth and attain higher weights at relatively younger age leads to prevent the delayed puberty.

Calving to Service Period: The mean calving to service period of 92.27 days was similar to the values reported by Rafique *et al.* [36] and Cilek [37]. Sattar *et al.* [12] reported calving to service period slightly lower than the current study. However higher mean value of calving to service period reported by Tadeese *et al*. [13] and Shiferaw *et al*. [38] in Ethiopia was 115±1.7 days. Our result was higher than the optimum value of 45- 60 days. So proper post partum cow management could overcome the deficiency and will lead to improved reproductive efficiency.

Days Open: Mean days open period of 156.44 was similar to the values reported by Tadeese *et al.* [13] and Cilek [37] and higher calving to conception interval was reported by Asimwe and Kifaro [39] and Estevez *et al.* [40] in Ethiopia. Days open period of present study was exceeded the optimum value of 75-90 days. The extended days open in the herd may be attributed to prolonged calving to service period, missed oestrus and service irregularities and poor management.

Services per Conception: The mean service per conception 2.1 was similar to the values reported by Niazi and Aleem [29] in Pakistan. The overall mean services per conception obtained in this study was lower than services per conception reported by Rao and Rao [7] in India while little higher value was reported by Saleem *et al*. [41] and Bertrand *et al*.[42] in Pakistan. The result of present study on service per conception suggested comparatively better insemination services at the herd during the study period. Successful service or insemination depends on many factors such as quality of semen, skill of the inseminator, timing of insemination and cows related factors. Management, nutrition and climatic conditions may also affect the success of insemination.

Gestation Length: The mean value of gestation length of present study was 276.02 days. Gestation length is a constant value for a breed. Almost same value of gestation length was reported by Sattar *et al*. [12] and Rathi *et al.* [43] in India. However little higher gestation length was reported by Dutta *et al*. [44] in India and Mustafa *et al.* [45] in Pakistan while slightly lower value of gestation length was indicated by Juneja *et al.* [18] in India.

Dry Period: Mean value of dry period observed in this study was 120 days is in agreement of the values reported by Tesfaye and Alemu [19] and Rao and Rao [7]. Slightly higher value of dry period was reported by Ahmad [46] in Pakistan. The higher value obtained from the present study may be due to improper dry off schedule and lack of confirmation of pregnancy.

CONCLUSION

The values for the traits of total milk yield, birth weight, lactation length and service per conception fall within the average values observed in other tropical countries. However, the traits of calving interval, age at first calving, calving to service period and days open values was higher than the optimum values recommended to maintain reproductive efficiency. The variation in productive and reproductive traits could be attributable to variation in level of feeding and management in addition to some environmental effects like rainfall, humidity and temperature on the cows. Lack of regular selection and absence of rigorous culling also could be the reasons for the variation. Level of performance of Jersey cattle at the Dayagama farm could be improved through adoption of proper feeding, housing, breeding and selection program.

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