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Productive Performance of Pure Friesian Cows Raised under Conditions of River Nile State, North Sudan

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Abstract

Data utilized in this study were obtained from the farm records of Al-Fayet project. The dairy farm is located in Gandatow, Shendi, River Nile State, as the first farm kept pure Friesian cattle. The main objectives of this study were to evaluate the productive performance of Friesian dairy cows and investigate the factors affecting those productive traits. A total of 138 performance records of Friesian cattle were used; covering the period from 2011 to 2014. The investigated data included total milk yield, lactation length and daily milk yield. The collected data were classified according to the parity number, season and year of calving. The data were analyzed using SPSS computer program. Analysis of variance was performed and means were separated using Duncan's multiple range test. The results showed that overall means of total milk yield, daily milk yield and lactation length were 5604.2 kg, 14.3 kg and 378.2 days, respectively. The total and daily milk yield were significantly ($P \leq 0.05$) affected by parity order, season and year of calving. On the other hand, year and season of calving had an insignificant ($P > 0.05$) influence on lactation length, while the trait was significantly ($P \leq 0.05$) affected by parity order. The study concluded that the productive performance of the pure Friesians cows raised in River Nile State, was better and higher than those estimates obtained from previous reports in Sudan. The productive performance of pure Friesian cows could be improved by adoption of proper management, feeding and breeding programs.

Keywords: *Sudan, pure Friesian, milk yield, lactation length*

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INTRODUCTION

Sudan is one of the largest animal populations in Africa, estimated at 31.200.000 cattle 39.568.000 sheep, 30.984.000 goats, and 4.773.000 camels [1]. Instead of the huge and large population of livestock and especially cattle, the country yearly increasingly imported milk as powder or liquid milk. To fill the huge gap between milk consumption and production, the country imported and reared pure high yielding exotic dairy cows and in addition adopted crossbreeding between high yielding exotic and indigenous breeds. The exotic breeds (*Bos Taurus*) were imported to Sudan for the first time in 1925 during colonization rule [2]. From 1984 to 1989 large scale importation of Holstein-Friesian heifers-in-calf took place by the newly established modern dairy companies [3]. However, the most of these dairy companies and farms for pure exotic and crossbred cattle are located at Khartoum State. In developing countries, the performance of high-yielding breeds imported from temperate countries with highly advanced production systems is often negatively affected due to genotype-environment interactions [4–7].

The present work was carried out to study the performance of recently and the first time imported pure Friesian cows and raised under conditions of River Nile State, Sudan.

The main objectives of this study are to:

(1) Evaluate the production performance of pure Friesian dairy cows under River Nile State conditions.
(2) Investigate the factors affecting production traits of pure Friesian cows.

MATERIALS AND METHODS

Farm Location and History of Foundation Herd

Data utilized in this study were extracted from the farm records of Al-Fayet Project. The farm is located in Gandatow, Shendi, and River Nile State, Sudan. The latitude and longitude are 16° 41' 29" N and 33° 26' 2" E. The farm was established in 2010 by importing pregnant Friesian cows from the Netherlands. The collected data included performance of imported cows and cows which were born in the farm.

Management System

Cows were kept in groups in a metal frame building. The roof is made of iron sheets and the floor is of concrete; the fencing is made of metal bars. Feeders and water troughs were placed in the shaded area. Machine milking was practiced out three times/day. Daily milk yield was recorded for each cow. Artificial insemination (A.I) was adopted in the farm; imported frozen semen of selected bulls (Holstein Friesian) was used to inseminate cows. Pregnancy was diagnosed using rectal palpation after 2 months of insemination. The cows were raised in a confined system receiving green forages such as alfalfa (*Medicago sativa*) and Rhodes grass offered twice a day. Also dairy cows concentrate ration was given to the animals according to their physiological status and milk yield. Pregnant cows were dried for two month prior to parturition.

Data Extraction and Manipulation

Data were extracted from farm records. A total number of 138 performance records of Friesian cattle were used; covering the period from 2011 to 2014. The data on productive performance included total milk yield, lactation length and daily milk yield. The data were arranged to examine the effect of season of calving, parity number, year of calving. Data were classified according to parity number into four parities (from 1st to 4th). The data were also classified into four groups according to year of calving (2011, 2012, 2013 and 2014). According to season of calving the data were classified into three seasons through dry summer from March to June, wet summer from July to October and winter from November to February.

Statistical Analysis

The collected data were coded and entered to a personal computer and subjected to statistical analysis. The data were analyzed using SPSS computer program [8], General Linear model (GLM) was performed. The analysis of variance was completed according to the following statistical model:

$$Yijkl = \mu + B_i + S_j + Y_k + e_{ijke}$$

Where:

Y_{ijkl} = Observation

μ = Overall mean

B_i= The fixed effect of the *i*th parity order (i= 1, 2,….4)

S_j= The fixed effect of the *j* th season of calving (j= 1, 2 or 3)

Y_k= The fixed effect of the *k*th year of calving (k= 1, 2,4)

SYjk= The effect of interaction between season and year of calving.

e_{ijkl} = The random error term

The means separation was performed using Duncan Multiple Range Test (DMRT) and results were presented as descriptive statistics (means, standard errors).

RESULTS

Descriptive Statistics of Productive Traits

The data in Table 1 summarized that the overall means, standard error, maximum and minimum of the studied traits of pure Friesian cattle in EL-Fayet Dairy Farm (2011–2014). Overall means and standard errors of total milk yield, lactation length and daily milk yield were 5604.2±531.1 kg, 378.2±19.6 days and 14.3±1.8 kg, respectively.

Table 1: *Number of Observations and Descriptive Statistics of Productive Traits of Pure Friesian Cattle.*

Parameters	No.	Mean ± SE	Minimum	Maximum
Total milk yield(kg)	138	5604.2±531.1	4553.1	6655.3
Daily milk yield (kg)	137	14.3±1.8	10.8	17.8
Lactation length (day)	142	378.2±19.6	339.4	416.9

FACTORS AFFECTING PRODUCTION TRAITS

Total and Daily Milk Yield

The effects of parity order, season and year of calving on total and daily milk yield were

presented in Table 2. The total and daily milk yield was significantly affected by parity order (P≤ 0.01). The total milk yield exhibited a decreasing trend as parity number increased. The highest total milk yield was recorded in the first parity (6763.3 kg), followed by second parity (6651.4 kg), while the third and fourth had significantly (P≤0.05) the lowest total milk yield. On the other hand, the highest daily milk yield was recorded in the second parity, followed by the first parity, while; the third and fourth parities had significantly the lowest daily milk yield. Season of calving significantly (P≤0.05) affected total and daily milk yields. The cows which calved in winter had significantly highest total and daily milk yields.

Table 2: *The Effect of Parity Number, Season and Year of Calving on Total and Daily Milk Yield.*

Parameters	Total milk yield (kg)		Daily milk yield (kg)	
	No.	Mean±SE	No.	Mean±SE
Parity number		**		***
1st	61	6763.3a±534.5	59	18.5a ± 1.8
2nd	56	6651.4a±467.2	57	20.4a ±1.5
3rd	18	4453.3b±701.1	18	9.8b ± 2.3
4th	3	4548.6b±1469.9	3	8.4b ± 4.9
Season of Calving		***		*
Dry Summer	14	5141.8b ±996.7	14	10.4b ± 3.3
Wet Summer	23	4060.6b±595.8	23	14.7b ± 1.9
Winter	101	7224.1a±614.2	100	17.9a ± 2.0
Year of Calving		***		*
2011	3	6491.6a±1514.2	3	9.2b ± 5.0
2012	40	7970.9a±671.7	39	15.2ab ± 2.2
2013	66	4479.6ab±927.9	65	12.1ab ± 3.0
2014	29	3770.4b±568.8	30	19.0a ± 1.9
Season*Year of Calving		***		NS

*NS, *,** and ***: significant effect at P>0.05, P<0.05, P<0.01 and P<0.001*
a,b *means with the same superscript were insignificantly (P>0.05) different*

The total milk yield of those cows calved in the winter season was greater by about 43.8% and 28.9 % than the yield of those cows calved in the wet and dry summer, respectively. Moreover, the year of calving had a significant (P≤0.05) influence on total and daily milk yields and the highest milk yield was recorded in the year 2012 (7970.9 kg). Moreover; the results revealed that total milk yield was significantly (P≤0.001) affected by interaction between season and year of calving but the daily milk yield was insignificantly (P>0.05) influenced.

Lactation Length

The effects of parity, season and year of calving on lactation length were outlined in Table 3. Analysis of variance revealed an insignificant (P>0.05) effect of parity number on lactation length, while season, year of calving and interactions between season and year of calving had a significant (P≤0.05) influence on lactation length. The cows which calved in dry summer had a significantly (P≤0.05) longer lactation period, than those which calved in winter season. However; cows which calved in wet summer had significantly (P≤0.05) the shortest lactation length. On the other hand, the cows which calved in the year 2011 had significantly (P≤0.05) longer lactation period (529.2±53.7 days) than those cows which calved in 2012 (482.9±25.1 days), while the cows that calved during 2013 and

Table 3: *Effect of Parity Number, Season and Year of Calving on Lactation Length (Day).*

Parameter	No.	Mean ± SE
Parity number		NS
1st	63	379.5a ±19.7
2nd	57	346.1a±17.2
3rd	19	403.8a±25.6
4th	3	383.3a± 55.0
Season of calving		*
Dry summer	14	428.6a ± 37.3
Wet summer	23	293.1b ± 22.3
Winter	105	391.5a ± 21.1
Year of calving		***
2011	4	529.2a ± 53.7
2012	40	482.9a ± 25.1
2013	69	355.8b ± 34.8
2014	29	195.0c ± 21.3
Season X year of calving		***

*NS, *,** and ***: significant effect at P>0.05, P<0.05, P<0.01 and P<0.001*
a,b *means with the same superscript were insignificantly (P>0.05) different*

2014 had significantly (P≤0.05) the shortest lactation length (355.8±34.8 and 195.0±21.3 days, respectively). Also the results showed that the lactation length was significantly (P≤0.05) influenced by interaction between season and year of calving.

DISCUSSION

The sale of milk is the primary income source for dairy farmers. Productively inefficient animals can drastically reduce the profits from the sale of milk. The overall average total milk yield in this study was 5604.2±531.1 Kg. This estimate is higher than the findings obtained and reported in Sudan [9–12]. The obtained value of total milk yield is also higher than the estimates mentioned by [13–15]. However; the present result is lower than that findings obtained by [16, 17], who found that the total milk yield of Holstein Friesian was 6050 and 5905±1895 kg, respectively. The variations in the different studies in the different countries and regions may be due to the effect of environmental conditions namely the combined effect of temperature, humidity and farm management level. The analysis of variance indicated that the total milk yield was significantly (P≤0.05) affected by parity order. The highest total milk yield was found in the 1st parity (6763.3 Kg), followed by the yield of 2nd parity (6651.4), then the yields of 4th (4548.6 Kg) and 3rd parity (4453.3). The decreasing trend of total milk yield from the 1st to 4th parity may be due to managerial factors, cow's condition (udders problem) or sampling error result from decreasing number of observation in later parities. Significant effect of parity number was reported by [18], who found that the parity number had a significant effect on total milk yield and the highest value was obtained in the third lactation followed by the second and first lactation. In Egypt, [19] analyzed 2095 records of Friesian cattle and found that milk yield in the first five parities was 4320±53, 5349±53, 4984±58, 4868±59 and 4389±85 kg, respectively. The disagreement result was reported by [20], who revealed that that parity number had no significant effect on total milk yield. Also disagreement findings was reported by [21] for Karana–Swiss and Karana–Friesian crossbred dairy cows. They noted that there were no significant differences among cows of different parity orders. Season of calving in the present study had a significant (P<0.001) effect on total milk yield. The average total milk yield of cows calved during winter season was higher than the value of cows calved during the dry and wet summer. This result is in line with that reported by [22, 23] for crossbred cattle raised in the Sudan. The present result is in disagreement with those reported by [10, 12, 24]. They noted that the season of calving had no significant (P>0.05) effect on total milk yield. In Sudan, [25] in their study on Butane cattle found that milk yield was sensitive to seasonal variation; cows calving in autumn (wet summer) produced more milk, apparently due to moderate environmental temperatures and availability of good quality fodder. The cows calved during the summer season were poor producers as these cows faced high temperatures and scarcity of fodder immediately after calving. The significant effect of year and season of calving on milk yield may be due to the variability in climatic conditions, fluctuations in the availability of nutrients and herd composition over the years.

The overall mean of daily milk yield was 14.3±1.8 kg in this study. This result is lower than those estimates reported by [26, 27, 15, 20, 9]. However, the present result is greater than those estimates mentioned by [28, 29]. These variations in daily milk yield among different herds may be due to the different feeding regimes, breeds, and management practices. The analysis of variance results revealed the presence of significant effects of the parity number on daily milk yield. The daily yield of the 2nd parity (20.4±1.5 kg) was significantly higher than the daily yield of the 1st parity (18.5±1.8 kg), 3rd parity (9.8±2.3 kg) and 4th parity (8.4±4.9 kg). Other researchers also found that the parity number had significant effect on daily milk yield [20]. The daily milk yield was significantly influenced by season of calving and the averages daily milk yield of those cows calved during winter, wet summer and dry summer were 17.9, 14.7 and 10.4 kg, respectively. These values are higher than the findings of [30] in his study on Holstein Friesian cows in Sudan, who found that cows produced 8.93, 8.1 and 7.83 kg per day during winter, wet summer and dry

summer, respectively. In this study, the effect of calving year on daily milk yield was significant and daily milk increased from 9.2±5.0 kg in 2011 to 19.0±1.9 kg in 2014. The variation in daily milk yield among different seasons and years could be due to changes in general management, feeding regime, availability of feedstuffs and fluctuation of environmental factors such as ambient temperature and humidity.

The overall average lactation length was 378.2±19.6 day. In the most modern dairy farms, a lactation length of 305 days is commonly accepted as a standard. A close result was reported by [31] for imported Friesian in Sudan (375.7±103.8 day as lactation length). The present finding is higher than the findings of [32–34]. Also this result is greater than the findings of [35], who reported that the lactation length of Friesian crosses, Sahiwal crosses, Sindhi crosses and indigenous dairy cows were 253.0±24.7, 256.3±24.3, 255.9±27.6 and 230.6±30.7 days, respectively. The analysis of variance showed that there was no significant (P>0.05) effect of parity order on lactation length. Similar results were found in Sudan by [36, 37]. However in Ethiopia, [38] reported that the parity order contributed significantly (P<0.01) to the total variation in lactation length and the magnitude of contribution was 6.14 %. Who revealed that the longest lactation length was obtained in the 4th parity (285.48±78.12 days) followed by 3rd (282.28±61.98 days), then 2nd (279.50±65.56 days) and the 1st (276.61±58.34 days), while 5th parity recorded the lowest length (255.16±55.04 days). The present study showed the significant (P<0.05) effect of season of calving on lactation length. The maximum lactation length was recorded for cows which calved during dry summer (428.6±37.3 days) and significantly greater than the lactation length of those cows calved in dry summer season. This result is in agreement with the findings obtained by [39, 40], while it is in disagreement with those findings reported [10, 12], who found insignificant (P>0.01) effect of season of calving on lactation length. In this study, the lactation length was significantly (P<0.001) affected by year of calving. However, insignificant influence of calving year was reported by [37]. The variations in lactation length among different studies might be due to variations in managerial practices and feeding regime, while the variation of trait among different seasons, years and parity orders could be due to environmental factors such as temperature and humidity, availability of feeds or might be due effect of the sampling size.

CONCLUSIONS

The study concluded that the productive performance (total milk yield) of pure Friesians raised and kept in the farm of Al-Fayet Project, located in River Nile State, was better and higher than the previous estimates obtained from different researchers in Sudan. The productive traits of pure Friesian cows could be improved by adoption of proper managerial practices, feeding and breeding programs.

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