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Research Paper

The Effect of Parity, Year and Season of Initiation of Lactation on Milk Production Traits of a Holstein Friesian Herd in the East of Khartoum State, Sudan.

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ABSTRACT
This study was initiated to investigate the effect of parity, year of calving and season of invitation of lactation on milk production traits of the Holstein Friesian dairy herd of Alwaha Farm east Khartoum State, Sudan. This included milk yield per lactation (MYL), lactation length (LL), 305-Day milk yield (305 DMY), mature equivalent yield (MEY), days to peak yield (DTPY) and days of peak yield (DOPY).The original data set of 578 lactation record was reduced to 304 records after removing those records with missing values. A three - way ANOVA using a GLM model in the SPSS statistical Package was used to analyze data.
Parity order significantly affected (P<0.01) milk yield per lactation (MYL), 305-day milk yield (305 DMY) and days of peak yield (DOPY), but did not significantly affect (P>0.05) lactation length (LL), mature equivalent yield (MEY) or days to peak yield (DTPY). The effect of year of calving was highly significant (P<0.001) on MYL, 305-DMY and MEY and significant on DOPY (P<0.01), but did not significantly affect (P>0.05) LL or DTPY. The season of initiation of lactation had affected all the studied milk traits with variable levels of significance. The interactions of parity x season, parity x year and season x year did not significantly affect (P>0.05) the milk production traits. The interactions of parity x season x year significantly affected (p<0.05). 305,DMY and MEY, but not the other milk production traits. It is concluded that the milk production traits in the herd under study responded variably to the factors of parity, year and season of calving under the prevailing environmental and management factors in that farm.
Key words: *Year, Season, Parity, MYL, LL, 305-DMY, DOPY, DTPY, MEY.*

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I. Introduction

The performance of Holstein Friesien cattle in tropical countries is always under investigation. Heat stress, disease and management practices are assumed to affect production traits of exotic breeds introduced to tropical environments. The history of importation of temperate dairy breeds to Sudan went back early as the year 1925, but establishment of commercial dairy farms based on large herds of imported Holstein Friesians started in the year 1984 (Elfagir 2002). Since then, investigation on performance parameters ofthis breed in Sudan has never stopped. This study is a continuation of these efforts to throw more light on the production performance of the breed and factors affecting them under the prevailing environmental and management conditions in different parts of Sudan.

Milk production in dairy cows is affected by many factors among which are parity number, year and season of calving. Parity significantly affected milk production as reported by Hansen *et. al* (2006), Sibru *et. al* (2019) and Utrera *et. al* (2013). The latter author also found that cows calving in the cold season had greater milk yield per day and efficiency for milk production than cows calving in the dry and rainy seasons. The effect of parity on peak milk yield is well documented by M.K.Rao and D. Sandarsan (1979), H.B.S. Bhadoria *et. al* (2002), Kocak and Ekiz (2008), Sahinler, S. (2009), H. Atashi *et. al* (2009), Macciott *et. al* (2011), A.K., Thiruvenkadan *et.al* (2014), Godfrey Bernard Nyamushamba *et. al* (2014), T. Strabel *et. al* (2014), Koloi S. *et. al* (2018) and Norma Patricia *et. a*l (2018). The effect of parity on days to peak yield is also shown by H. B. S.

Bhadoria *et. al* (2002), B. Rekik *et. al* (2003), Hatungumukama *et. al* (2008), Sahinler, S. (2009), H. Atashi *et. al* (2009) and A.K., Thiruvenkadan *et. al* (2014). The effect of year and season of calving on peak yield and days to peak yield has been elucidated by M.K. Rao and D. Sandarsan (1979), Tekerli, Mustafa (2000), H.B.S. Bhadoria *et. al* (2002), T. Strabel *et. al* (2004), H. Atashi *et. al* (2009), K. N. Taher (2012), A. K., Thiruvenkadan *et. al* (2014), Nawal and Raman (2015) and Koloi, S. *et. al* (2018). Furthermore, M. K. Rao and D. Sandorsan (1979) and A. K. Thiruvenkadan *et. al* (2014) have documented the effect of season on lactation milk yield and parity on milk yield traits. The findings of A. K. Thiruvenkadan *et. al* (2014) and Wubshet Woldegiorgis Kassa (2020) have also shown the effect of season of calving on 305 day milk yield. The latter author has also recorded the significant effect of year of calving and parity on 305-day milk yield and parity on lactation length. The objective of this study was to investigate the effects of parity, year and season of initiation of lactation on milk production traits of a Holstein Friesian herd in the East of Khartoum State, Sudan.

II. MATERIALS AND METHODS

Data:

The original set consisted of production records of 578 lactations following calving of Holstein Friesian Herd in a farm in the East of Khartoum State, Sudan. Records with missing values were removed from the original data. Data of years 2011, 2012 and 2018 and Cows with parity greater than 5 were deleted from the original data, because the number of cows declined obviously, which could not represent the effect of seasonal change and parity on the milk production. Moreover, the outlier's records were determined and excluded from the analysis. This editing procedure resulted in 304 records for analysis. The number of cows in different parities and seasons and years were different.

Variables:

The independent variables were parity group included (1, 2, 3, 4, 5), Calving season (3 classes: autumn, from July to October; winter, from November to February and summer, from March to June), and year of calving (5 classes: 2013-2017). The dependent variables were total milk yield(MYL) per lactation, lactation length (LL), 305-d milk yield (305-DMY), mature equivalent yield (MEY), days of peak yield (DOPY) and days to peak yield (DTPY).

Statistical analyses:

The data were analyzed using a three-way ANOVA using a GLM model in the SPSS Statistical software package. Tukey test was used to determine the significant differences among means of analyzed parameters. Significance was declared when ($P<0.05$).

III. Results :

Levels of statistical significance of fixed effects for milk yield traits are in Table 1. Parity of cow and calving year were highly significant ($P<0.01$) sources of variation for all traits studied, except for lactation length and days to peak yield, while season was significant ($P<0.05$) for all milk yield traits.The interactions of parity ×season, parity × year, season × year and parity × season × year had no significant effect ($P> 0.05$) on milk production traits in this farm.

Table 1: Levels of statistical significance of fixed effects for milk production traits

Fixed effect	Milk Production trait					
	MYL (kg)	LL (d)	305-D MY	MEY	DTPY	DOPY
PARITY	**(0.006)	NS (0.334)	** (0.003)	NS (0.285)	NS (0.900)	**(0.002)
SEASON	**(0.001)	***(0.000)	*(0.041)	*(0.039)	**(0.007)	***(0.000)
YEAR	***(0.000)	NS (0.770)	***(0.000)	***(0.000)	NS (0.118)	**(0.007)
PARITY * SEASON	NS (0.347)	NS (0.224)	NS (0.333)	NS (0.372)	NS (0.389)	NS (0.460)
PARITY * YEAR	NS (0.081)	NS (0.333)	NS (0.140)	NS (0.126)	NS (0.862)	NS (0.049)
SEASON * YEAR	NS (0.107)	NS (0.140)	NS (0.122)	NS (0.163)	NS (0.111)	NS (0.494)
PARITY * SEASON * YEAR	NS (0.129)	NS (0.059)	* (0.016)	** (0.007)	NS (0.065)	NS (0.070)

MYL= Milk Yield per Lactation; LL = Lactation Length; 305-D MY= 305 day Milk Yield; MEY= Mature Equivalent Yield; DTPY= Days To Peak Yield; DOPY= Days Of Peak Yield.

*< 0.05; **< 0.01; ***<0.001; Ns denotes not significance at 5%

1. Parity effects

The effects of parity on milk production traits are illustrated in Table (2). Parity number had significantly affected MYL and 305-D M Y and DOPY (P<0.01), table (1). Second parity had higher total-MYL, 305-DMY and MEY than first and older parities. The parity number had no effect
(P> 0.05) on LL and DTPY.

Table 2: The effect of Parity number on milk yield per lactation, lactation length, mature equivalent yield, days to peak milk yield, and days of peak milk yield.

Parity	No.	MILK PRODUCTION TRAIT					
		MYL (kg)	LL (d)	305-D MY	MEY	DTPY	DOPY
1	**56**	6081.39± 1738.2 ab	375.64 ± 81.7	5230.04 ± 1210.0 bc	5974.05 ± 1387.2 ab	72.98 ± 41.0	30.52± 4.1 a
2	**65**	6456.57± 1580.8 a	386.91 ± 81.8	5773.5 ± 1216.0 a	6062.3 ± 1254.1 a	69.03± 41.2	33.21 ± 7.3 b
3	**79**	5669.12± 1507.7 bc	356.91 ± 61.2	5406.03 ± 1372.0 ab	5507.3 ± 1393.5 bc	71.13 ± 43.2	33.74 ± 5.3 b
4	**68**	5309.75± 1358.4 c	359.56 ± 77.5	5146.60 ± 1183.8 bc	5190.40 ± 1202.5 cd	75.90 ± 44.0	33.97 ± 4.9 b
5	**36**	5153.16± 980.5 c	359.22 ± 58.5	4855.11 ± 819.0 c	4946.22 ± 824.6 d	85.53± 46.4	33.97 ± 5.9 b

MYL= Milk Yield per Lactation; LL = Lactation Length; 305-D MY= 305 day Milk Yield; MEY= Mature Equivalent Yield; DTPY= Day To Peak Yield; DOPY= Day Of Peak Yield.
Means within the same column in each category carry different superscripts are significantly different (P<0.05).

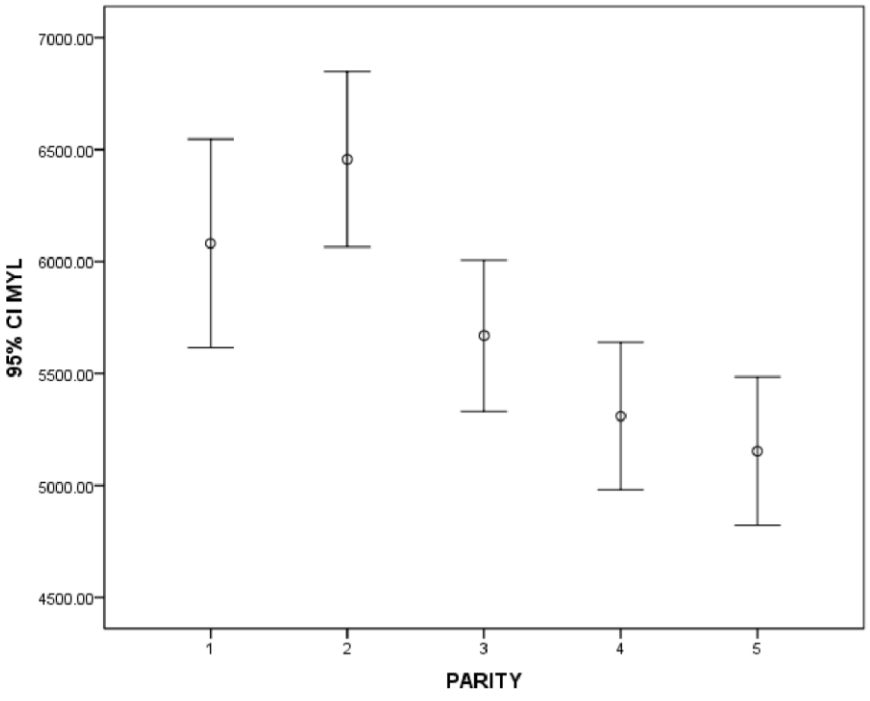

Figure 1: The effect of parity number on milk yield per lactation

2. Calving season effects

The effects of calving season on milk production traits are illustrated in Table (3). Milk yield per lactation (MYL), lactation length (LL) were significantly (P<0.05) greater in cows that calved during the summer season compared to those calved during autumn and winter. While DTPY and DOPY were significantly (P<0.05) greater in cows that calved during the winter season compared to those calved during other seasons. Non-

significant differences (P>0.05) were observed in 305-DMY and MEY traits between cows that calved during different seasons.

Table 3: The effect of Calving season on milk yield per lactation, lactation length, mature equivalent yield, days to peak milk yield, and days of peak milk yield.

Season	No.	MILK PRODUCTIO N TRAIT					
		MYL (kg)	LL (d)	305-D MY	MEY	DTPY	DOPY
Autumn	**158**	5562.54 ± 1489.8 b	356.33 ± 59.34 b	5240.93± 1276.35 a	5414.87± 1333.2 a	78.89 ± 45.0 a	32.50 ± 5.2 b
Winter	**67**	5814.67 ± 1609.9 ab	352.60 ± 84.1 b	5563.43± 1313.9 a	5737.50 ± 1368.8 a	79.37 ± 44.6 a	35.15 ± 5.5 a
Summer	**79**	6154.54± 1550.7 a	403.03 ± 80.0 a	5306.00 ± 1076.6 a	5756.03 ± 1222.3 a	58.86 ± 33.4 b	32.61 ± 4.7 b

MYL= Milk Yield per Lactation; LL = Lactation Length; 305-D MY= 305 day Milk Yield; MEY= Mature Equivalent Yield; DTPY= Day To Peak Yield; DOPY= Day Of Peak Yield.
Means within the same column in each category carry different superscripts are significantly different (P<0.05).

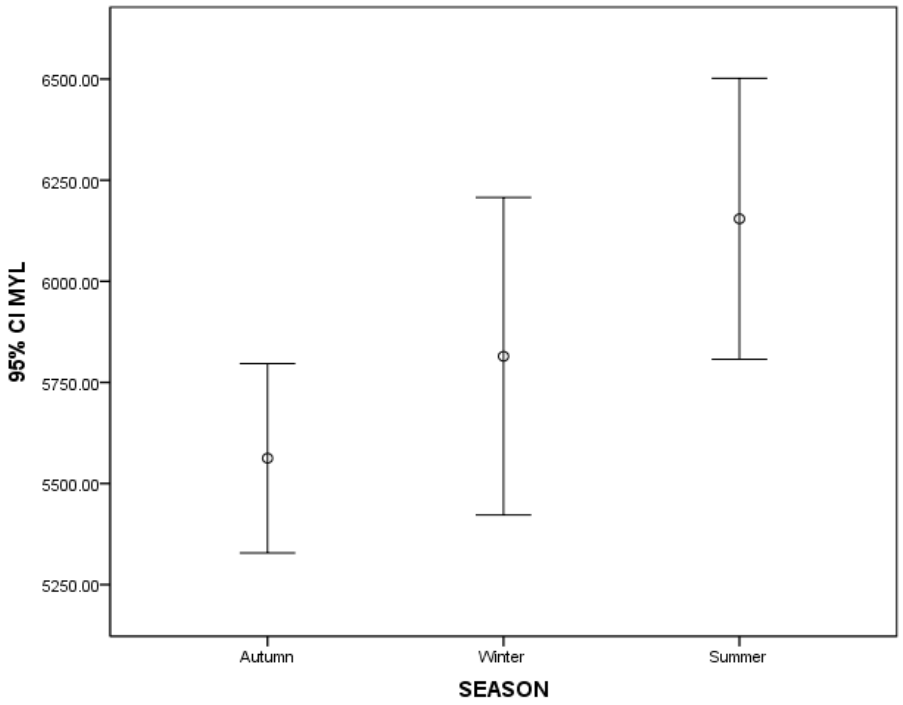

Figure 1: The effect of calving season on milk yield per lactation

3.Calving year effects

The effects of calving year on milk production traits are illustrated in Table (4). Milk yield per lactation, 305-DMY and MEY were significantly (P<0.05) greater in cows that calved during the year 2013 compared to those calved during other years. While DTPY and DOPY were significantly high (P<0.05) in cows that calved in the year 2017 compared to the other years.

Table 4: The effect of Calving year on milk yield per lactation, lactation length, mature equivalent yield, days to peak milk yield, and days of peak milk yield.

Year	No.	MILK PRODUCTION TRAIT					
		MYL (kg)	**LL (d)**	**305-D MY**	**MEY**	**DTPY**	**DOPY**
13	53	6686.28 ± 1615.0 a	374.81± 88.3 ab	5924.58 ± 1263.0 a	6523.79 ± 1303.5 a	66.49 ± 32.5 bc	33.46 ± 5.5 ab
14	69	5903.36 ± 1700.9 b	395.07± 76.3 a	5154.5362 ± 1278.8 b	5489.72 ± 1323.3 b	78.42 ± 46.1 ab	32.42 ± 4.7 b
15	67	6452.09 ± 1268.8 ab	361.30 ± 68.7 ab	6115.37 ± 1045.2 a	6299.27 ± 1029.3 a	53.97± 34.8 c	32.40 ± 5.4 b
16	69	4926.21 ± 1059.5 c	351.96 ± 65.2 b	4746.25 ± 989.3 bc	4823.72 ± 1003.2 c	84.96± 40.0 ab	32.69 ± 5.1 b
17	46	4799.36 ± 959.3 c	351.00± 60.2 b	4632.70 ± 710.2 c	4679.31 ± 709.7 c	87.39 ± 52.5 a	35.41 ± 5.1 a

MYL= Milk Yield per Lactation; LL = Lactation Length; 305-D MY= 305 day Milk Yield; MEY= Mature Equivalent Yield; DTPY= Day To Peak Yield; DOPY= Day Of Peak Yield.
Means within the same column in each category carry different superscripts are significantly different (P<0.05).

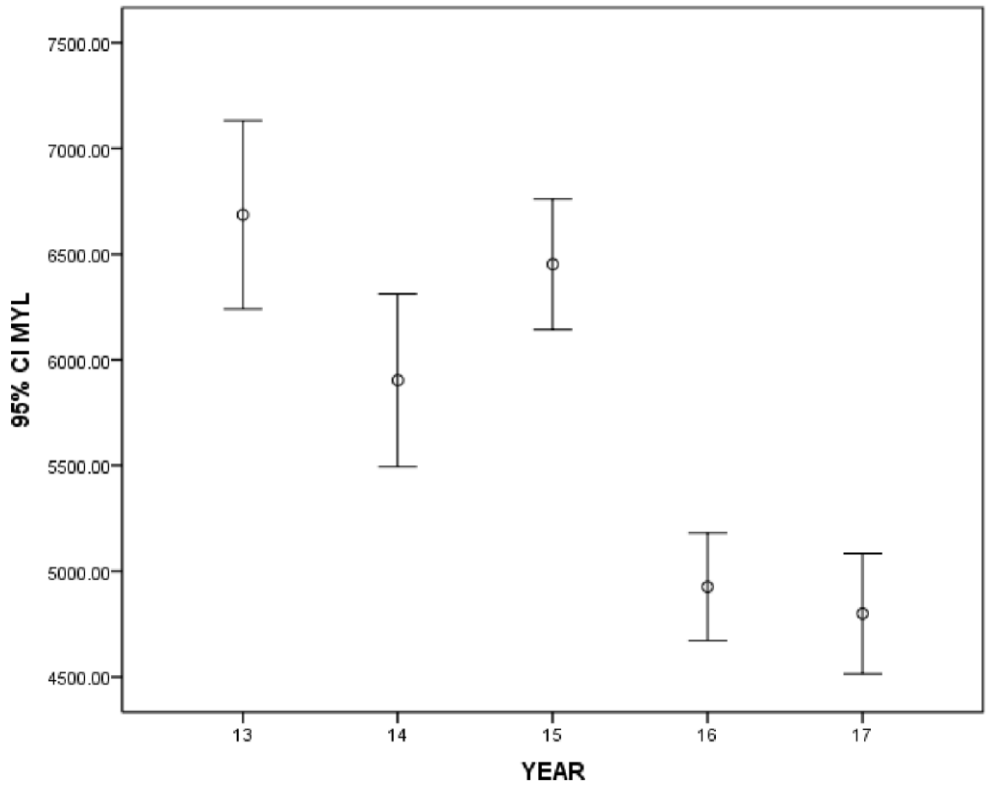

Figure 1: The effect of calving year on milk yield per lactation

IV. DISCUSSION

The results of this study showed that parity order and calving year were highly significant sources of variation for all milk yield traits, except for lactation length (LL) and days to peak yield (DTPY) while the effect of season was significant for all milk yield traits.

The findings of this study were in line with the findings of some workers and differed with others concerning the response of milk yield traits to parity order, year and season of calving. Angel Rios-Litra *et.al* (2013) agreed with the results of this study on the effect of parity order and season of calving on milk yield per lactation (MYL), but disagreed to the effect of season of calving on (LL) which is documented by this study. Elfagir (2002) and Rana (2015) found similar results to this work on the significant effect of parity, year and season of calving on MYL. The significant effect of season of calving on (LL) reported in this study agreed with

the findings of Romero *et.al* (1992), Tekerli, M. and Kocak, S. (2009) and Rana (2015), but in contrary to the results reported by Mutaz, M.M. (2006) and Maluit, B.D. (2010). In this study parity exerted an insignificant effect on (LL) in line with the results reported by Wala *et.al* (2004), Badri *et. al* (2011) and Rana (2015) and contrary to the results shown by Kumar *et.al* (2014). The significant effect of parity order on MYL shown in this research is in line with the results reported by Amassaib *et. al*(2011), but in disagreement with the works of Bhatngar *et. al* (1986) and Eid *et. al* (2012). The results of this study showed a significant effect of season of calving on MYL which agreed with the results obtained by Ageeb *et. al* (1991) and disagreed with the fmdings of yousif *et. al* (1998), Ali *et. al* (2003), Mutaz, M.M. (2006) and Maluite, B.D. (2010). The significant effect of year of calving on LL reported by this study was also reported by Badri *et. al* (2011), but contradicted by Rana (2015).

The results of this study showed that parity order, year and season of calving had significantly affected 305-day milk yield (305-DMY) which came in line with the results obtained by Tekerli, Mustafa (2000) and Wubshet Woldegiorgis Kassa *et al* (2020) and also with the findings of R.E. Mostert *et. al* (2001) for the significant effect of parity and season of calving. It is shown by this work that parity order and year of calving had significantly affected days on peak yield (DOPY), but not days to peak yield (DTPY), while season of calving had significantly affected both traits. In this respect B.Rekik *et. al* (2003) reported that the ascending phase of the lactation curve was not affected by parity and calving year while days in milk until peak depended only on the rank of lactation, on the other hard Guler, Okay and Yamar, Mete (2009) showed that calving season did not affect days in milk at peak yield and peak yield. Also Atashi *et. it*(2009) showed that first parity cows showed the highest persistency while multiparous cows reach their peak production earlier in the lactation than first parity cows. Peak yield was greater for the second lactation and was greatest for the third lactation. They also showed that peak yield happened earlier in those cows calving in spring compared to those calving in other season. Cows with greater initial yield tend to have higher 305 D milk yield and peak yield and reach peak yield at the earlier stage of lactation. Nawal Kishor Pareek and Raman Narang (2015) agreed with the findings of this study on the significant effect of parity, year and season of calving on DOPY. Also K. N. Taher (2012) found that peak milk yield was significantly influenced by season and year of calving and days to peak yield were significantly affected by year of calving as reported by this work. The findings of this study agreed and disagreed with the results obtained by other workers on the response of milk traits to the effects of parity, year and season of calving. This might be due to the prevailing environment and management conditions in the farm under study.

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