

Seasonal Variability Affecting Lactation Traits in Bunaji and Friesian Crosses

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Target audience: Animal breeders, Animal nutritionist and Dairy farmers.

Abstract

This study was conducted to evaluate the effect season on lactation traits of Bunaji and Friesian crosses at National Animal Production Research Institute. Lactation records of 178 cows from January 2015 to August 2021 were analysed for Lactation length (LL), Total Milk Yield (TMY) Average daily milk yield (ADMY), Milk yield at early lactation (MYEL), Milk yield at mid lactation (MYML), Milk yield at late lactation (MYLL), Persistency (PER) and peak milk yield (PMY), the seasons were divided into early rain (ER) late rain (LR) early dry (ED) and late dry (LD). The data collected was subjected to normality test and was found to be skewed, it was transformed using log10 and analysed using descriptive statistics and analysis of variance using statistical analysis systems (SAS) software. Significant ($p < 0.05$) effect of season was observed in most of the parameters across all the seasons where ED season had better overall LL, TMY, ADMY, MYEL, MYLL PER and PMY (2.42 days, 3.16 L, 0.76 L, 2.78 L, 2.70 L, 2.58 L, 1.52 days, and 0.88 L/day, respectively) than LR ED and LD season, PER in Bunaji and MYML, MYLL PER and PMY in 50% FxB are not significantly different ($p > 0.05$). It is concluded that, early dry season exhibited better lactation traits compared to other seasons. Dairy farmers should consider the seasonal variations in lactation traits when managing their herds to optimize milk production and further research could focus on understanding the underlying mechanisms of how seasons impact lactation traits and explore potential strategies to mitigate any negative effects.

Key note: Lactation, Traits, Breed Season

Description of problem

Seasonal changes in weather element such as rainfall, temperature, relative humidity and photoperiod is one of the many constraints that have effect on milk production in the tropics, this leads to the scarce availability of natural forages during the drier seasons (1).

In the dry season, high temperatures have been shown to decrease feed intake, which lowers milk production (2). It was reported that (3), the season had a substantial impact on all lactation traits in Sanga cows, and that the season of calving had an effect on milk traits in most cattle breeds. It is assumed that

season effect the yield during the calving season and the next season (4). The season effect for a trait that is measured over a long time, e.g., lactation yield, is therefore a combination of a succession of seasons was an important source of variation in daily milk yield, lactation yield, and lactation length (4). The current study aimed at investigating the effect of season on milk yield and other lactation traits in Bunaji and Friesian x. Bunaji cows.

Materials and Methods

Study area

The data for the studies was collected from the Dairy Research Unit of National Animal Production Research Institute (NAPRI) Shika Zaria. Shika is located at 22km North-West of Zaria, it is located within the Northern Guinea Savannah Zone of Nigeria, with latitude 11° 09' 01.78*' N and longitude 7° 39' 14.79' E at an altitude 671m above sea level (15). The climate is relatively dry with a mean annual rainfall of 700-1400mm. the rain starts at between late April and early May to mid-October. The dry season begins around the middle of October, with cold weather that ends in February. This is followed by relatively hot weather between March and April just before the rain begins. The mean minimum daily temperature is from 14-24°C during the cold season while the mean maximum daily temperature is from 19-36°C during the hot season. The mean relative humidity during the dry and wet seasons is 21% and 72%, respectively (16).

Experimental Animals and Management

Bunaji and Friesian x Bunaji (50% and 75%) cows from the dairy unit of National Animal Production Research Institute were utilised,

consisting of 46 Bunaji, 64 50% Friesian x Bunaji and 68 75% Friesian x Bunaji cows. The animals were kept under semi-intensive system of management under controlled grazing, with supplementation of formulated concentrate rations morning and evening after grazing. Periodic vaccinations against pests and diseases were given, and adequate treatment against infection was also provided. The sample was collected randomly, irrespective of the cow's age, seasons, and parity, but subsequently into early rain (ER), late rain (LR), early dry (ED) and late dry (LD) season.

Lactation records of Bunaji and Friesian x Bunaji cows from January 2015 to August 2021 were analysed for lactation length (LL), total milk yield (TMY), average daily milk yield (ADMY), milk yield at early lactation (MYEL), milk yield at mid lactation (MYML), milk yield at late lactation (MYLL), persistency (PER), and peak milk yield (PMY);

- A. Lactation length (LL in days): total milking days less colostrum days measured in days
- B. Total milk yield (TMY in l): overall milk produced per cow during the lactation cycle, measured in liters
- C. Average daily milk yield (ADMY in l): the sum total of TMY divided by lactation days
- D. Milk yield at early lactation (MYEL in l): Total milk production per cow at early lactation (first one-third of the total lactation days) measured in liters.
- E. Milk yield at mid-lactation (MYML in l): Total milk produced per cow at mid-lactation of a given lactation circle (second one-third of the total lactation days) measured in liters.
- F. Milk yield at late lactation (MYLL in l):

total milk produced per cow at the last phase of lactation before drying off (last one-third of the total lactation days) measured in litters.

- G. Persistency (PER days): Number of days during which peak milk yield is maintained before it declines, estimated in days
- H. Peak milk yield (PMY l/day): it is the quantity of milk produced when maximum yield is achieved; it is expressed as litter per day.

Statistical Analysis

The data collected were subjected to normality test and was found to be skewed, it was transformed using Log¹⁰, it was analysed using descriptive statistics and analysis of variance in General linear model of SAS (17), and significantly different means were separated using Duncan's Multiple Range Tests.

Results

Descriptive Statistics for Milk Production Traits of Bunaji and Friesian crosses in different seasons

The descriptive statistics for milk production traits of Bunaji, 50% Friesian x Bunaji and 75% Friesian x Bunaji cows as affected by seasons is shown in Table 1. The results showed that the early dry season had the longest mean **lactation length (LL)** of 275 days, followed by the early rainy season (237 days) then late rainy season (224 days), while late dry season (211.52 days) is the least, this implies that the early dry season exhibited a longer duration of lactation compared to early rain, early dry and late season. **Result on total milk yield (TMY) showed that the highest mean TMY was in the early dry**

season (1856.88 L,) followed by the late rainy (1341.48 L) then early rainy (1503 L), the least was observed in late dry season (1063.10 L) which means that the early dry season shows a higher total milk yield compared to the other seasons. As presented in table 1 Similarly, early dry season had the highest mean **average daily milk yield (ADMY)** of 6.32 L/day, followed by the early rainy (5.95 L/day) then late rainy season (5.67 L/day), and late dry season is the least (4.64 L/day). Early dry season had higher average daily milk yield compared to other seasons.

Overall Effect of Season on Lactation Characteristics of Bunaji and Friesian Crosses

Table 2 shows the effect of seasons on lactation characteristics of **Bunaji, 50% Friesian x Bunaji and 75% Friesian x Bunaji cows**. The results revealed that there were significant ($P < 0.05$) differences in the lactation traits. For example, lactation length (LL) differed significantly between the seasons, with the early rain (ER) and late rain (LR) having similar ($p > 0.05$) values, while the early dry (ED) season exhibited significantly ($p < 0.05$) longer lactation length (2.42 days) than the late dry (LD) season (Figure 4.3). Similarly, total milk yield (TMY) significantly varied across seasons; with ER and LR differ non-significantly ($p > 0.05$), with ED with significantly ($p < 0.05$) higher TMY (3.16 L) than LD season. Average daily milk yield (ADMY) did not show significant differences among the seasons. Similarly, MYEL, MYML, MYLL, PER and PMY are also significantly ($p < 0.05$) affected by the season.

Table 1 Descriptive statistics for milk production traits of Bunaji and Friesian crosses in different seasons

Season	Traits	N	Mean	SE	Min	Max	CV
Early rain	LL(Days)	45	237.00	11.96	123.00	406.00	13.06
	TMY(L)		1503.00	133.63	234.00	3423.50	28.30
	ADMY(L)		5.95	0.36	1.29	10.33	19.59
	MYEL(L)		627.63	58.95	136.00	1560.50	31.59
	MYML(L)		511.98	43.85	60.00	1040.50	26.31
	MYLL(L)		360.36	34.50	23.00	822.50	32.89
	PER(Days)		33.00	2.34	7.00	77.00	31.12
	PMY(L/day)		8.75	0.53	1.97	14.62	19.96
Late rain	LL(Days)	37	224.00	12.74	91.00	353.00	14.56
	TMY(L)		1341.48	129.31	332.00	2941.00	28.63
	ADMY(L)		5.67	0.33	2.03	9.27	14.99
	MYEL(L)		559.25	55.97	119.50	1332.00	30.87
	MYML(L)		495.31	44.52	114.21	964.00	28.95
	MYLL(L)		319.13	32.16	76.20	762.50	31.30
	PER(Days)		29.00	2.30	7.00	58.00	17.57
	PMY(L/day)		7.97	0.51	2.63	14.23	19.18
Early dry	LL(Days)	71	275.00	8.19	112.00	453.00	5.02
	TMY(L)		1856.88	139.50	347.50	4383.00	33.29
	ADMY(L)		6.32	0.38	2.64	17.56	20.80
	MYEL(L)		767.05	61.95	145.00	2358.00	38.05
	MYML(L)		662.75	48.46	121.00	1695.00	35.57
	MYLL(L)		456.09	34.03	81.50	1144.00	31.65
	PER(Days)		39.00	2.02	7.00	80.00	33.66
Late dry	PMY(L/day)	25	8.67	0.51	2.99	18.03	39.63
	LL(Days)		211.52	12.85	110	338	20.37
	TMY(L)		1063.10	142.84	216.00	2594.50	27.18
	ADMY(L)		4.64	0.44	1.62	8.30	17.82
	MYEL(L)		429.56	64.11	86.00	1348.00	34.63
	MYML(L)		368.45	48.13	73.00	899.50	25.31
	MYLL(L)		265.08	37.52	56.09	689.50	30.77
	PER(Days)		28.00	2.86	12.00	63.00	21.83
PMY(L/day)	6.77	0.67	2.03	12.50	19.25		

ER: early rain, LR; late rain, ED: early dry, LD: late dry, LL: Lactation length, TMY: total milk yield, ADMY: average daily milk yield, MYEL: milk yield at early lactation, MYML: milk yield at Mid lactation, MYLL: milk yield at late lactation, PER: Persistency, PMY: peak milk yield, N: number of observations, SE: standard error, Min: minimum, Max: maximum, CV: coefficient of variation.

Table 2: Least Square Means (\log_{10}) \pm Standard Error for the overall Effect of Season on Lactation Characteristics of Three breeds of Cattle

Parameters	ER	LR	ED	LD	LOS
LL(Days)	2.35 \pm 0.02 ^b	2.32 \pm 0.02 ^b	2.42 \pm 0.02 ^a	2.30 \pm 0.03 ^b	*
TMY(L)	3.02 \pm 0.04 ^b	2.96 \pm 0.03 ^b	3.16 \pm 0.03 ^a	3.01 \pm 0.05 ^c	*
ADMY(L)	0.73 \pm 0.02 ^a	0.68 \pm 0.02 ^a	0.76 \pm 0.02 ^a	0.67 \pm 0.03 ^b	*
MYEL(L)	2.70 \pm 0.04 ^{ab}	2.65 \pm 0.03 ^b	2.78 \pm 0.03 ^a	2.51 \pm 0.06 ^c	*
MYML(L)	2.61 \pm 0.04 ^{ab}	2.58 \pm 0.04 ^b	2.70 \pm 0.03 ^a	2.46 \pm 0.05 ^c	*
MYLL(L)	2.41 \pm 0.05 ^b	2.42 \pm 0.04 ^b	2.58 \pm 0.04 ^a	2.30 \pm 0.06 ^c	*
PER(Days)	1.43 \pm 0.04 ^b	1.41 \pm 0.04 ^b	1.52 \pm 0.04 ^a	1.44 \pm 0.06 ^b	*
PMY(L/day)	0.89 \pm 0.02 ^a	0.86 \pm 0.02 ^a	0.88 \pm 0.02 ^a	0.81 \pm 0.03 ^b	*

ER: Early rain, LR: Late rain, ED: Early dry, LD: Late dry, MS: Mean Square LL: Lactation length, MYEL: milk yield at early lactation, MYML: milk yield at mid lactation, MYLL: milk yield at late lactation, PER: Persistency, LY: Lactation yield, DPL: Dry period length, LOS; level of significant, *, significant at 5%.

Effect of Season on Lactation Characteristics of Bunaji Cows

The effects of season on lactation characteristics of Bunaji cows is presented in Table 3. The results showed that lactation length (LL) was significantly ($P < 0.05$) different among the seasons, with the early dry (ED) having the longest duration (2.40 days), followed by the late rain (LR) and late dry (LD), while the early rain (ER) had the shortest LL value ($P < 0.05$). Total milk yield (TMY) also varied significantly ($P < 0.05$) among the seasons, with the ED season showing the highest TMY (2.85 liters), followed by LR (2.75 L) and ER (2.62 L), with LD (2.52 L) having the lowest ($P < 0.05$) TMY. Average daily milk yield (ADMY) significantly ($P < 0.05$) differed with seasons, with ED (0.49 L) having the highest ADMY, followed by LR (0.44 L) and ER (0.38 L), and LD (0.30 L) having the lowest ADMY. MYEL, MYML, MYLL and PMY are significantly ($p < 0.05$) affected by seasonal variation, whereas PER is not significant ($p > 0.05$) across the seasons

Effect of Season on Lactation Characteristics of 50% Friesian x Bunaji cows

Table 4 shows the effect of different seasons on lactation characteristics within 50% Friesian x Bunaji cows. Lactation length (LL) was significantly ($P < 0.05$) different among the seasons; with the early dry (ED) season having the longest LL (2.41 days), followed by the early dry (ED) and late rainy (LR) seasons, while the late dry (LD) season had the shortest ($P < 0.05$) LL (2.25 days). Total milk yield (TMY) also varied significantly ($P < 0.05$) across seasons, with the ED having the highest TMY (3.35 liters), followed by ER (3.11 L) and LR (2.94) while LD (2.81 L) having the lowest ($P < 0.05$) TMY. Average daily milk yield (ADMY) significantly ($P < 0.05$) differed among the seasons, with the ED (0.80) having the highest value, followed by EL and LR, while LD (0.66) having the lowest. However, not significant ($p > 0.05$) effect of season on MYML, MYLL, PER and PMY across all the seasons

Table 3: Least Square Means (Log₁₀) ± Standard Error for the Effect of Season on Lactation Characteristics of Bunaji

Parameters	ER	LR	ED	LD	LOS
LL(Days)	2.24±0.02 ^{bc}	2.30±0.03 ^{ab}	2.40±0.01 ^a	2.28±0.03 ^c	*
TMY(L)	2.62±0.05 ^c	2.75±0.04 ^b	2.85±0.01 ^a	2.52±0.06 ^d	*
ADMY(L)	0.38±0.03 ^c	0.44±0.03 ^b	0.49±0.01 ^a	0.30±0.03 ^d	*
MYEL(L)	2.24±0.04 ^c	2.34±0.04 ^b	2.44±0.01 ^a	2.13±0.06 ^d	*
MYML(L)	2.15±0.05 ^c	2.28±0.04 ^b	2.37±0.01 ^a	2.05±0.06 ^d	*
MYLL(L)	2.02±0.07 ^c	2.16±0.05 ^b	2.30±0.01 ^a	1.93±0.07 ^d	*
PER(Days)	1.45±0.05 ^a	1.50±0.05 ^a	1.60±0.03 ^a	1.48±0.07 ^a	NS
PMY(L/day)	0.51±0.05 ^b	0.53±0.02 ^b	0.60±0.01 ^a	0.40±0.03 ^c	*

^{abc}= means with different superscripts within the rows are significantly different at 5%, FxB: Friesian x Bunaji Cross, LL: Lactation length, TMY: Total milk yield, ADMY: Average daily milk yield, MYEL: milk yield at early lactation, MYML: milk yield at mid lactation, MYLL: milk yield at late lactation, PER: Persistency. LOS; level of significant, *, significant at 5%, ^{NS}; not significant

Table 4: Least Square Means (Log₁₀) ± Standard Error for the Effect of Season on Lactation Characteristics of 50% Friesian x Bunaji cows

Parameters	EL	LR	ED	LD	LOS
LL(Days)	2.33±0.042 ^{ab}	2.32±0.062 ^{ab}	2.41±0.051 ^a	2.25±0.047 ^b	*
TMY(L)	3.11±0.066 ^{ab}	2.94±0.073 ^{ab}	3.35±0.079 ^a	2.81±0.097 ^b	*
ADMY(L)	0.78±0.032 ^{ab}	0.72±0.036 ^b	0.80±0.039 ^a	0.66±0.047 ^c	*
MYEL(L)	2.73±0.071 ^b	2.56±0.079 ^b	2.78±0.086 ^a	2.67±0.105 ^b	*
MYML(L)	2.65±0.062	2.48±0.069	2.68±0.075	2.61±0.091	NS
MYLL(L)	2.45±0.070	2.33±0.078	2.50±0.085	2.46±0.104	NS
PER(Days)	1.46±0.063	1.28±0.070	1.38±0.076	1.28±0.093	NS
PMY(L/day)	0.95±0.033	0.92±0.037	0.96±0.03	0.90±0.09	NS

^{abc}= means with different superscripts within the rows are significantly different at 5%, FxB: Friesian x Bunaji Cross, LL: Lactation length, TMY: Total milk yield, ADMY: Average daily milk yield, MYEL: milk yield at early lactation, MYML: milk yield at mid lactation, MYLL: milk yield at late lactation, PER: Persistency. LOS; level of significant, *, significant at 5%, ^{NS}; not significant

Effect of Season on Lactation Characteristics of 75% Friesian x Bunaji Cows

Table 5 shows the effect of different seasons on lactation characteristics among 75% Friesian x Bunaji cows. The results showed that there were significant (P<0.05) differences across the traits measured. Lactation length (LL) showed significant (P<0.05) variations across seasons; with the early dry (ED) exhibiting the longest LL (2.50 days), followed by the late rainy (LR), while the early rainy (ER) and late dry (LD)

seasons had comparatively shorter LL (P<0.05). Total milk yield (TMY) significantly differed among the seasons, with the ED and LR seasons showing the highest TMY (3.42 and 3.41 liters, respectively), followed by the ER season, while the LD season displayed the lowest (P<0.05) TMY. Average daily milk yield (ADMY) significantly varied across seasons, with the ED having the highest value, followed by the LR and ER seasons, and the LD season had the lowest (P<0.05) ADMY. Similarly, ED recorded the significantly

Table 5: Least Square Means (\log_{10}) \pm Standard Error for the Effect of Season on Lactation Characteristics of 75% Friesian x Bunaji cow

Parameter	ER	LR	ED	LD	LOS
LL(Days)	2.38 \pm 0.03 ^b	2.43 \pm 0.03 ^b	2.50 \pm 0.04 ^a	2.36 \pm 0.06 ^b	*
TMY(L)	3.20 \pm 0.05 ^b	3.41 \pm 0.06 ^a	3.42 \pm 0.05 ^a	3.00 \pm 0.11 ^c	*
ADMY(L)	0.81 \pm 0.04 ^b	0.90 \pm 0.04 ^a	0.95 \pm 0.04 ^a	0.74 \pm 0.07 ^c	*
MYEL(L)	2.79 \pm 0.05 ^b	2.89 \pm 0.06 ^a	3.04 \pm 0.05 ^a	2.59 \pm 0.10 ^c	*
MYML(L)	2.71 \pm 0.06 ^b	2.76 \pm 0.06 ^b	2.94 \pm 0.06 ^a	2.71 \pm 0.11 ^b	*
MYLL(L)	2.53 \pm 0.07 ^b	2.56 \pm 0.08 ^b	2.82 \pm 0.07 ^a	2.51 \pm 0.13 ^b	*
PER(Days)	1.46 \pm 0.06 ^{ab}	1.47 \pm 0.07 ^{ab}	1.61 \pm 0.06 ^a	1.39 \pm 0.12 ^b	*
PMY(L/day)	0.98 \pm 0.04 ^{ab}	1.00 \pm 0.02 ^{ab}	1.10 \pm 0.02 ^a	0.95 \pm 0.05 ^b	*

^{abc}= means with different superscripts within the rows are significantly different at 5%, FxB: Friesian x Bunaji Cross, LL: Lactation length, TMY: Total milk yield, ADMY: Average daily milk yield, MYEL: milk yield at early lactation, MYML: milk yield at mid lactation, MYLL: milk yield at late lactation, PER: Persistency, LOS: level of significant, *, significant at 5%,

($p < 0.05$) higher MYEL, MYML, MYLL, PER and PMY compared to ER, LR and LD season.

Discussion

The current study revealed a seasonal variation in lactation traits of the breeds under studies, with early dry season having the best for most of the traits. Superiority of lactation performance in early dry season may be due to high dry matter accumulation in forage materials couple with high feed supplementation and abundance of crop residues in the institute (5) reported a similar result on Holstein Friesian Crosses in Central Highlands of Ethiopia were they reported a higher total and daily milk yield and other milk traits during early dry season. Similarly, (6) reported a significant effect of season on milk yield characteristics although, the findings revealed that, milk was significantly higher during the early wet season (April-June) instead of early dry season, this was also in line with some previous studies (7, 8). The variations observed in the lactation length, total and average daily milk yield and other lactation traits with season may be due to the changes in quality and quantity of

pasture available to the cows to feed on across the seasons (7). The significant effect of season on the milk yield is an indication of the high contribution of the environment to the milk yield characteristics of the cows, thus poor management and other environmental factors can affect the milk yield characteristics of these cows. Regarding the milk yield characteristics of these cows. Similarly, (9) reported that, season of the year had significant effects on milk production of dairy cattle, seasonal changes affected the milk production performance of different breeds under same management practices. The major influences of milk production are due to the sources of variation in milk production, lactation length and dry period are genotype, environment and the interaction between the two.

The similar results were also reported (10). Season had a significant effect on the milk yields. The milk yield of dairy cows in the Badghis dairy farm is at a high peak in spring compared to summer and winter seasons. Also, the milk yield of dairy cows is high at 3rd lactation and low at 1st lactation. The milk yield of Holstein dairy cows is at a low level in the Badghis Dairy Farm. Feed with good

quantity and quality increases the milk yield of dairy cows. Contrarily, some authors (3, 11; 12) have reported low daily milk yield during the dry and hot periods. Season influences feed and forage availability as well as quality and quantity of the feed resources which in turn affect milk produced (1; 13). As forages grow, they tend to accumulate more fibre at the expense of the nutritive components (14). The highest milk yield is usually recorded in major rains where feed and forages are in abundance (11)

It is reported that (9) the seasonal influence on the milk production of Holistan, Garsi and cross breed (CB) cows. The average highest seasonal milk production of Garsi and CB was in spring and summer season, 9.22 and 9.02 liter, respectively and Holistan was highest in spring and summer season (8.261 liter), respectively. The overall average milk production of CB, Holistan and Garsi were 8.86, 7.98 and 7.37 respectively. The seasonal variation and milk production performance of all three breeds were found highly significant. Because the other season production was low. The average milk production of 2470 ± 37 L milk production in spring season followed by 2427 ± 41 L in summer and lowest in winter, as 2403 ± 82 L respectively. The average milk production of Garsi breed in different seasons was estimated and it was noticed that the highest average of 2460 ± 35 L milk production in spring season followed by 2434 ± 14 L in summer and lowest in winter, as 2413 ± 62 L respectively. The average milk production of CB Doragh breed in different seasons was estimated of 2540 ± 35 L milk production in spring season followed by 2457 ± 25 L in summer and lowest in winter, as 2432 ± 20 L respectively (9) (18) reported that the season and year affect the milk production

performance amongst cow breeds and their finding was 5.3 liters with coefficient of variation 15.28%.

Conclusion and application

1. Significant effect of season on various lactation traits was observed, early dry season exhibited better lactation traits compared with other seasons.
2. Calving should be synchronised to be at late raining season to allow for abundance of feed supply during the peak stage of lactation
3. Further studies could focus on understanding the underlying mechanisms of how seasons impact lactation traits and explore potential strategies to mitigate any negative effects.

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