

Relationships between Milk Yield, Post-Partum Body Weight and Reproductive Performance in Friesian × Bunaji Cattle

O. O. Oni*, I. A. Adeyinka, R. A. Afolayan¹, B. I. Nwagu, A. E. O. Malau-Aduli, C. B. I. Alawa and O. S. Lamidi
National Animal Production Research Institute, Ahmadu Bello University, P.M.B. 1096, Shika - Zaria, Nigeria

ABSTRACT : The data consisted of 369 lactation records for calvings over a sixteen-year period (1972-1987) and included only cows that had normal milk records. The data were analysed using a linear model containing the fixed effects of parity, year of calving and season of calving. The least squares means±S.E. were 1,273±58.4 kg for milk yield, and for post-partum body weight (kg) at 2, 3 and 4 months after calving were 343.40±3.96, 346.10±4.10 and 352.54±4.26, respectively. With the exception of season of calving, the effects of parity and year of calving were significant ($p < 0.01$) on the performance of the animals. Thus, the mean milk yields 1162, 1351 and 1350, were similar for pre-, peak- and post rainy seasons, respectively. On the other hand, as parity increased from 1 to 3, milk yield also increased, but thereafter, there was a gradual decline in milk yield. Similarly, post-partum body weight also increased with parity. However, no consistent pattern for year effect was observed which probably was a reflection of the variation in climatic conditions, or forage quality and/or availability. The phenotypic correlations between milk yield and post-partum body weights were negative and small (ranging from -0.01 to -0.08). However, high milk production in cows was associated with longer calving interval. The implications from the phenotypic correlations are suggestive of one or two possibilities. Firstly, selection for increased body weight may actually result in decreased milk yield. Also, a substantial genetic antagonism may exist between milk yield and fertility in the crossbred cows. Therefore, it is important that selection to improve milk production should take into consideration the reproductive performance of the cows. (*Asian-Aust. J. Anim. Sci.* 2001. Vol 14, No. 11 : 1516-1519)

Key Words : Friesian × Bunaji, Milk Yield, Body Weight, Reproductive Performance

INTRODUCTION

Several studies have indicated that there is some genetic antagonism between high milk yield and fertility (Everett et al., 1966; Whitmore et al., 1974; Majjala, 1976; Berger et al., 1981).

Milk production in Nigeria is based on indigenous breeds, exotic breeds and their crosses, although indigenous cattle maintained under the agro-pastoral system constitutes the main source of milk supply. Reports have shown that a rapid means of improving milk production is by crossbreeding the indigenous cows with exotic breeds. Thus, results of studies conducted at the National Animal Production Research Institute (NAPRI), Shika, Nigeria, on the performance of crossbreds of Friesian with Bunaji, have indicated an improvement of over 60% in milk yield by the first cross, and that a further increase in the level of Friesian blood resulted in an additional gain in yield, but with decreasing magnitude. There was also a marked reduction in calving interval and age at first calving in the crosses. The exotic breeds and their crosses, however, require higher nutritional levels, are less resistant to the local diseases and are generally less adaptable to tropical conditions.

Our objectives therefore were to evaluate relationships among milk yield, calving interval (a reproductive trait) and

post-partum body weight in lactating half Friesian × Bunaji cows in a tropical environment.

MATERIALS AND METHODS

The data for this study were taken from the dairy herd of the National Animal Production Research Institute (NAPRI), Shika, Nigeria. The data consisted of 369 records of post-partum body weights at 2, 3 and 4 months after calving, calving interval and total milk yield of half Friesian × Bunaji cows that calved over a sixteen-year period (1972-1987).

The study area, Shika, is located on latitude 11°N at 640 m above sea level and lies within the northern guinea savannah zone. The average annual precipitation is 1,100 mm, which occurs from late April or May to October, with a peak between June and September (peak-rains). The wet season is usually followed by 'harmattan', a period of cool, dry weather which lasts from mid October to January (post-rains). This is followed by dry, hot weather from February to May (pre-rains). Thus, the dry periods are long and pronounced, often causing serious shortage of feed and water supply for the animals. The mean maximum temperature varies from 22 to 27°C depending on season and the mean relative humidity during harmattan and the wet season are 30 and 72%, respectively. Thus, the whole year was divided into three seasons: Pre-rains (February - May), Peak-rainy (June-September) and Post-rains (October-January).

* Corresponding Author: O. O. Oni. E-mail: olusolaoni@yahoo.com

¹ University of Adelaide, South Australia.

Received December 8, 1999; Accepted July 2, 2001

Cows were kept outdoors in paddocks all the year except during the morning and afternoon milking when they were in a parlour. On pasture, trees provided shade. At milking, a concentrate supplement (guinea corn and undelinted cotton seed cake or groundnut cake) was fed at 3.5 kg/cow/day. In the rainy season, cattle grazed on pasture consisting of *Andropogon gayanus* (Gamba) and *Digitaria smutsii*. Maize silage (approximately 40 kg/cow) or Gamba hay (about 12 kg/cow) was provided daily during the dry season in the paddocks. Salt block and water were available to cows on pasture *ad libitum*. The cows were machine-milked in the morning and evening daily, while body weights were taken at monthly intervals.

Age at calving and calving interval were computed from the recorded dates of birth and calving. Records of animals of uncertain dates of birth and calving or incomplete milk production were excluded. All parities above five were coded 5, because of fewer numbers of records outside parity five. Data were analysed by method of least-squares analyses of variance according to Harvey (1977) using SAS (1987) computer programme. A linear model used for the analysis was:

$$Y_{ijkl} = \mu + T_i + S_j + P_k + e_{ijkl}$$

where, Y_{ijkl} = Observation on the i^{th} cow of the k^{th} parity, calving within the j^{th} season of the l^{th} year.

μ = the overall mean

T = fixed effect of i^{th} year of calving ($i = 1, 16$)

S = fixed effect of j^{th} season of calving ($j = 1, 3$)

P = fixed effect of k^{th} parity ($k = 1, 5$)

e_{ijkl} = the random error associated with each observation.

The phenotypic correlations (and tests of significance) between milk yield, calving interval and post-partum body weights were computed using the Pearson's correlation module, according to SAS (1987) procedures.

RESULTS AND DISCUSSION

The analysis of variance for the traits are shown in table 1, while the least-squares means and standard errors for measures of performance are presented in table 2.

The effect of parity was significant ($p < 0.01$) for milk

yield, calving age and post-partum body weights, but was not significant for calving interval. Similarly, year of calving was significant ($p < 0.001$) for age at calving and post-partum body weight at 2 months, but was not significant for other traits. On the other hand, seasonal effect was not significant for any of the traits. Also there was no consistent pattern for year effect which might reflect the variation in climatic conditions or forage quality and/or availability.

However, when the parity increased from 1 to 3, the milk yield also increased; but thereafter, a gradual decline in milk yield then set in. Similar observations have been made by Adeneye and Adebajo (1978) who reported that the milk production of Friesian cattle in Western Nigeria was highest during the 4th lactation. Likewise Licitra et al. (1990) reported that the yields of Modicana and Holstein cows increased with parity. The result of this study also confirms the earlier findings of Malau-Aduli et al. (1996) who analysed data on the dairy performance of animals in this herd. Morales et al. (1989) gave a probable explanation to this observation of relationship between milk yield and parity. He noted that when most heifers calve for the first time, they are yet to reach full maturity in growth. Consequently, their physiological and anatomical features for milk secretion and production have not been fully developed. However, as the animal advances in age, there is a concomitant increase in milk production and yield until a limit is reached and beyond which an inverse relationship comes into effect.

Parity had little or no effect on calving interval (C.I.) as the differences between parities were not significant, although the C.I. increased with parity. However, parity significantly ($p < 0.001$) influenced post-partum body weights as body weight increased with parity.

Table 1 shows that none of the traits was affected by season of calving. Thus, the mean milk yields were similar, 1162, 1351, 1350 for pre-, peak-and post-rains, respectively. The fact that milk yield during the pre-rainy season (when the temperature was highest 27°C) was not significantly different from other periods, shows that hot temperature within the range of 21-30°C per se was not an important

Table 1. Least-squares analysis of variance of factors affecting performance

Source	df	Mean Squares					
		Milk Prod	C.I.	Calv age	Bwt2m	Bwt3m	Bwt4m
Parity	4	1128901.44**	3743.44	30283271.12***	23724.86**	20059.69***	15245.73**
YOC	15	1370318.28**	7244.68	1065552.67***	7312.19**	5192.98	5425.32
SOC	2	601479.55	1682.91	198812.22	2871.65	2221.49	3894.94
Error		510557.49	5080.52	87002.78	3441.57	3811.98	4187.37
		(154)	(223)	(347)	(232)	(225)	(223)

Error df in parentheses.

$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Bwt2m, Bwt3m and Bwt4m = Post-partum body weights at 2, 3 and 4 months, respectively.

C.I. = Calving interval, Calv-age = age at calving, YOC = Year of calving, SOC = Season of calving.

Table 2. Least-squares means (lsm) \pm s.e. of performance traits across parities, seasons and years of calving

	No.	Milk Prod.	No.	C.I.	No.	Bwt2m	No.	Bwt3m	No.	Bwt4m	
Overall Mean	176	1273.48 \pm 58.40	244	395.24 \pm 4.60	254	343.40 \pm 3.96	247	346.18 \pm 4.10	245	352.54 \pm 4.25	
Parity											
1	52	952.09 \pm 121.19	-	-	103	314.47 \pm 7.13	101	320.00 \pm 7.15	102	332.66 \pm 7.47	
2	47	1420.36 \pm 139.95	96	388.26 \pm 8.90	75	342.71 \pm 8.30	72	347.46 \pm 8.53	72	353.44 \pm 8.93	
3	38	1475.54 \pm 131.47	67	389.15 \pm 10.68	34	372.33 \pm 11.25	37	380.69 \pm 11.7	35	390.01 \pm 12.65	
4	25	1304.58 \pm 214.80	50	409.01 \pm 12.06	22	393.47 \pm 14.95	22	393.77 \pm 15.8	21	396.61 \pm 16.80	
5	14	1288.41 \pm 167	37	409.84 \pm 14.31	15	409.45 \pm 17.73	15	393.78 \pm 18.5	15	390.15 \pm 19.14	
Season											
Feb. -May	65	1162.54 \pm 119.24	92	396.24 \pm 9.78	90	373.29 \pm 8.81	91	368.62 \pm 8.80	87	376.61 \pm 9.39	
June-Sept.	56	1351.37 \pm 118.21	65	396.25 \pm 10.54	63	363.72 \pm 9.50	59	360.51 \pm 10.0	58	363.29 \pm 10.62	
Oct.-Jan.	55	1350.69 \pm 116.77	87	404.71 \pm 9.36	101	396.24 \pm 9.31	97	372.28 \pm 9.71	100	377.82 \pm 10.09	
Year											
1	2	1827.46 \pm 521.28	-	-	1	276.00	-	2	371.33 \pm 44.5	2	385.77 \pm 46.76
2	7	1639.79 \pm 286.79	2	458.66 \pm 51.55	8	403.38 \pm 21.94	5	386.06 \pm 28.7	7	425.43 \pm 25.81	
3	12	1209.54 \pm 230.93	5	367.54 \pm 33.28	11	391.08 \pm 19.59	11	387.41 \pm 20.4	11	388.24 \pm 21.74	
4	19	1338.64 \pm 181.67	11	388.45 \pm 22.92	20	386.17 \pm 14.46	20	393.88 \pm 15.3	18	390.91 \pm 16.74	
5	23	1935.48 \pm 161.58	16	431.74 \pm 18.62	25	386.65 \pm 13.06	24	391.18 \pm 14.2	23	373.21 \pm 15.26	
6	16	1521.85 \pm 187.52	21	404.63 \pm 16.10	16	365.97 \pm 15.82	15	347.09 \pm 17.1	17	344.99 \pm 16.93	
7	15	1299.56 \pm 189.83	32	416.52 \pm 12.96	10	392.82 \pm 19.32	9	379.83 \pm 21.4	8	376.94 \pm 23.67	
8	12	1269.15 \pm 212.31	19	376.50 \pm 16.89	3	341.13 \pm 34.73	3	353.69 \pm 36.5	3	363.76 \pm 38.34	
9	4	1634.16 \pm 365.65	11	397.17 \pm 22.11	6	354.76 \pm 25.46	6	366.27 \pm 26.8	6	364.63 \pm 28.16	
10	1	823.30	8	456.14 \pm 25.70	10	360.33 \pm 19.52	7	352.32 \pm 24.2	6	355.64 \pm 27.60	
11	8	1184.87 \pm 269.27	9	412.74 \pm 24.76	15	389.81 \pm 16.36	16	387.63 \pm 16.8	16	387.55 \pm 17.65	
12	9	1118.75 \pm 241.08	12	367.26 \pm 21.04	20	377.84 \pm 13.82	21	371.70 \pm 14.3	21	379.68 \pm 15.00	
13	13	789.36 \pm 205.52	15	410.98 \pm 19.10	25	374.71 \pm 12.62	26	366.74 \pm 13.1	25	382.80 \pm 13.97	
14	20	880.46 \pm 165.14	27	384.81 \pm 14.07	34	349.71 \pm 10.47	33	348.89 \pm 11.1	34	356.84 \pm 11.56	
15	12	1046.75 \pm 214.55	34	390.25 \pm 16.25	35	327.80 \pm 10.09	33	330.86 \pm 10.9	33	334.59 \pm 11.42	
16	3	819.12 \pm 432.98	20	334.05 \pm 52.13	15	329.52 \pm 15.80	16	339.36 \pm 16.2	15	350.20 \pm 17.44	

C.I., Bwt2m, Bwt3m and Bwt4m = as in table 1.

factor in controlling milk yield in the crossbreds (McNab, 1966; McIntyre, 1967; Remond and Vermorel, 1983; Perez-Beato, 1983; Alhassan et al., 1985). The concentrate provided during lean period of fodder availability might have marked the seasonal fluctuation in forage availability which can have a direct influence on milk yield as reported earlier (Alhassan et al., 1985). However, contrary to Alhassan et al. (1985) who reported that they obtained higher milk yield during post-rains, in the present study, the highest yield was during the peak-rainy season, and this agreed with the report of Abubakar and Buvanendran (1981).

Table 2 also reveals that cows calving during the pre-rains had longer C.I. compared to other periods, although the difference was not significant. The implication of this for dairy cow management is that animals calving during this period may require more services per conception, if the fertility of the herd is not to be seriously affected.

The phenotypic correlations between reproduction trait

(C.I.), post-partum body weights and milk yield showed that milk yield and C.I. were positively and moderately correlated (0.26), meaning high milk yield was associated with longer C.I. This is in agreement with the report of Whitmore et al. (1974). This indicated that high-producing cows might require longer period to conceive (i.e. more services per conception). The estimated 305 day yield (305DY, kg) was 1507, 2022, 1802 kg for pre, peak, post-rains respectively, while the overall mean was 1,777 \pm 68. Similarly, the correlations between milk yield and post-partum body weights are negative, although small and non-significant, ranging from -0.01 to -0.08. The implication however is that selection for increased body weight may actually result in decreased milk yield. As suggested by McDaniel and Legates (1965), milk yield can be improved without materially increasing body weight of dairy cattle. Furthermore, because larger cows cost more to maintain, this clearly would not be a profitable selection scheme. However, as expected, the post-partum weights at the

respective ages were highly and significantly ($p < 0.01$) correlated, ranging from 0.79 to 0.87.

The results of this study agreed with the report of Batra et al. (1986) that there is some antagonism between reproduction traits and milk yield. There seems to be a positive phenotypic correlation between a cow's production traits and milk yield. This relationship may be due to the fact that high-producing cows do not show visible signs of heat as early as other cows. Thus, selection for milk yield without simultaneously considering reproduction might be detrimental. Incidentally, improvement in reproduction by selection alone has not been very effective because of low heritability. On the other hand, the use of progeny test for production traits has been very successful, especially for large herds.

Thus, it is therefore necessary to use a selection programme that combines production and pedigree information with reproduction for genetic improvement in both milk yield and reproduction.

REFERENCES

- Abubakar, B. Y. and V. Buvanendran. 1981. Lactation curves of Friesian-Bunaji crosses in Nigeria. *Livest. Prod. Sci.* 8:11-19.
- Adeneye, J. A. and A. K. Adebajo. 1978. Lactational characteristics of imported British Friesian cattle in Western Nigeria. *J. Agric. Sci., Camb.* 91:645-651.
- Alhassan, W. S., V. Buvanendran and O. W. Ehoche. 1985. Seasonal influences on milk production in Friesian-Bunaji crosses in Northern Nigeria. *J. Agric. Sci., Camb.* 104:231-233.
- Batra, T. R., A. J. Lee and A. J. McAllister. 1986. Relationships of reproduction traits, body weight and milk yield in dairy cattle. *Can. J. Anim. Sci.* 66:53-65.
- Berger, P. J., R. D. Shanks, A. E. Freeman, and R. C. Laben. 1981. Genetic aspect of milk yield and reproductive performance. *J. Dairy Sci.* 64:114-122.
- Buvanendran, V., M. B. Olayiwole, K. T. Piotrowska and B. A. Oyejola. 1981. A comparison of milk production traits in Friesian \times White Fulani crossbred cattle. *Anim. Prod.* 32:165-170.
- Everett, R. W., D. V. Armstrong and L. J. Boyd. 1966. Genetic relationship between production and breeding efficiency. *J. Dairy Sci.* 49:879.
- Harvey, W. R. 1977. Instruction for use of least squares and maximum likelihood: general purpose program. Mimeo, Ohio State University, Columbus.
- Licitra, G., P. A. Oltenacu, R. W. Blake, A. Lanza and G. D'Urso. 1990. Season of calving and parity effects on milk yield and reproduction of Modicana and Holstein cows in Sicily. *J. Dairy Sci.* 73:224.
- Malau-Aduli, A. E. O., B. Y. Abubakar, O. W. Ehoche and N. I. Dim. 1996. Studies on milk production and growth of Friesian \times Bunaji crosses. 1. Dairy performance. *Asian-Aus. J. Anim. Sci.* 9:503-508.
- McDaniel, B. T. and J. E. Legates. 1965. Association between body weight predicted from heart girth and production. *J. Dairy Sci.* 48:947.
- McIntyre, K. H. 1967. A comparative study of the performance of dairy cows during summer and winter in a sub-tropical climate. *Aust. J. Exp. Agric. Anim. Husbandry* 7:400-407.
- McNab, A. P. 1966. Persistency of lactation and fluctuations in milk production in a sub-tropical environment. *Dairy Sci. Abstr.* 28:541.
- Morales, F., R. W. Blake, T. L. Stanton and M. V. Hahn. 1989. Effects of age, parity, season of calving and sire on milk yield of Carora cows in Venezuela. *J. Dairy Sci.* 72:2161-2169.
- Perez-Beato, O. 1983. Influence of abiotic factors, temperature, relative humidity and rainfall on milk yield in a herd of Holstein-Friesians in Cuba. *Dairy Sci. Abstr.* 45:792.
- Remond, B. and M. Vermorel. 1983. Climate and seasonal influences on milk production at pasture. *Dairy Sci. Abstr.* 45:792.
- SAS Institute Inc. SAS/STATTM. 1987. Guide for personal computers, version 6 Edt. Cary, NC 1028pp.
- Whitmore, H. L., W. J. Tyler and L. E. Casida. 1974. Effects of early postpartum breeding in dairy cattle. *J. Anim. Sci.* 38:339-346.