STUDIES ON MILK PRODUCTION AND GROWTH OF FRIESIAN × BUNAJI CROSSES: II. GROWTH TO YEARLING AGE

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Summary

The data analysed consisted of body weight records at birth, and at 3, 6, 9 and 12 months of age of 549 half Friesian × Bunaji crossbred heifers collected over a twenty-five year period (1965-1989). Least squares means ± s.e. of body weights at birth, 3, 6, 9 and 12 months of age were 26.7 ± 1.3, 72.4 ± 4.5, 112.9 ± 6.9, 147.2 ± 9.2 and 182.1 ± 11.1 kg, respectively. Year of birth was highly significant (p < 0.01) in affecting body weights at all ages, while the effect of month of birth was not. Seasonal influence on birth weight and body weights at 3 and 6 months of age was significant (p < 0.05). Phenotypic correlations between body weights at all ages were positive and highly significant (p < 0.01), ranging from 0.30 to 0.79. The results of this study showed that the beneficial effect of crossbreeding Friesian with Bunaji cattle was reflected in the growth performance of the F_1 crosses, since they grew faster than the indigenous Bunaji from birth to yearling age. The study also indicated that heifer selection for yearling body weight can be done early on the basis of weights at 3 and 6 months of age.
(Key Words: Growth, Yearling Age, Friesian × Bunaji)

Introduction

Growth as reflected by body weight changes at fixed ages, is of utmost importance in the rearing of heifers since the future of any dairy operation depends to a large extent, upon a successful programme of raising calves for replacement purposes.

In the traditional pastoral system of dairy production, calves graze along with their dams and obtain milk directly through suckling. Growth rate of the calves therefore depends largely upon the nutritional status of the pastures being grazed. In modern dairy production systems in Nigeria, crossbreeding of indigenous and exotic cattle is practised where pure exotics cannot be maintained. One of such crossbreeding programmes was that involving the Friesian and Bunaji cattle at the National Animal Production Research Institute, Shika.

Since differences in the body weight of dairy heifers are caused by factors attributable to various genetic and environmental sources (Rathi and Balaine, 1984), this study had the objectives of evaluating the body weights of Friesian × Bunaji halfbreds at birth, 3, 6, 9 and 12 months of age; ascertaining the effects of season and year of birth on their growth to yearling age and estimating phenotypic correlations between body weights at fixed ages.

Materials and Methods

The data utilized for this study originated from the dairy herd of the National Animal Production Research Institute, Shika, Nigeria. Located between latitude 11° N and longitude 12° E at an altitude of 640 m above sea level, Shika lies within the Guinea savannah zone where the average annual rainfall is 1,100 mm, most of which falls during May to October. Peak rainfall is recorded during the wet season (June to September) when the relative humidity and daily temperature average 72% and 25°C, respectively. Following the rainy season is a period of dry, cool weather called 'harmattan' which marks the onset of the dry season. This extends from mid-October to January. The dry season (February to May) is characterised by very hot weather conditions. At this

period, daily temperatures range from 21°C to 36°C, while mean relative humidity is 21%. Details of the dairy herd management procedures at Shika have been published elsewhere (Malau-Aduli et al., 1995).

The data analysed consisted of 549 body weight records at birth (BWT), and at 3 (WT3), 6 (WT6), 9 (WT9) and 12 (WT12) months of age of Friesian × Bunaji heifers born between 1965 and 1989. The data were subjected to least squares analysis using SYSTAT (1988). The following statistical model was used :

$$Y_{ijk} = \mu + YR_i + S_j + M_k + E_{ijkl}$$

Where Y_{ijk} = the observation on the 1st calf born in the kth month within the jth season of the ith year group

μ = overall mean

YR_i = fixed effect of the ith year of birth group (i = 1, 5)

S_j = fixed effect of the jth season of birth (j = 1, 3)

M_k = fixed effect of the kth month of birth (k = 1, 12)

E_{ijkl} = random error associated with each record with

expectation 0 and σ_e^2

Year of birth was classified into five-yearly intervals while season of birth was classified as dry (February to May), wet (June to September) or harmattan (October to January). Phenotypic correlations were computed using the Pearson Correlation Module while tests of significance at 1 and 5% levels were carried out using the Bonferroni probabilities as spelt out in the procedures of SYSTAT (1988).

Results and Discussion

Birth weight (BWT)

Month of birth was not significant in affecting body weights at all ages as depicted in table 1. This supports the findings of Riveros (1990) who studied the effects of month of birth on the growth of grazed Friesian calves. Season and year of birth effects were however significant (p < 0.05 and p < 0.01).

TABLE 1. LEAST SQUARES ANALYSIS OF FACTORS AFFECTING GROWTH TO YEARLING AGE*

Source	d.f.	Mean squares				
		BWT	WT3	WT6	WT9	WT12
MOB	11	25.54	300.19	687.06	668.44	919.22
SOB	2	125.31[a]	777.23[a]	1,569.98[a]	1,400.22	1,963.22
YOB	24	196.35[b]	1,997.51[b]	4,708.24[b]	8,838.61[b]	12,162.80[b]
ERROR	511	29.94	220.13	421.89	537.51	711.91

* [a] = p < 0.05, [b] = p < 0.01.

MOB = Month of birth, SOB = Season of birth, YOB = Year of birth, BWT = Birth weight, WT3 = Weight at 3 months of age, WT6 = Weight at 6 months of age, WT9 = Weight at 9 months of age, WT12 = Weight at 12 months of age.

Table 2 shows the least squares means across seasons of birth. Overall, BWT averaged 26.7 ± 1.3 kg. This value agrees very closely with the reported birth weights of 26.0 kg in Friesian × Lanka (Tilakaratne and Matsukawa, 1983), 26.96 kg in Friesian × Gir (Shrivasta et al., 1985) and 26.2 kg in Friesian × Kerala (Nair et al., 1985). On the other hand, it exceeded the birth weight values of 24.05 and 24.70 kg reported for pure Bunaji calves by Ehiobu and Ngere (1988) and Oni et al. (1988), respectively.

Table 2 also shows that calves born during the dry season had the lowest birth weight (23.9 kg), while their counterparts born during the harmattan had the highest (30.9 kg). The most probable explanation for this observation could be that the requirement of the dam for the rapid growth of the foetus at the last trimester of pregnancy for calves born during the harmattan, coincided

with the availability of good quality forage (Tawonezvi, 1989). Similar reports of significant seasonal effects on birth weights of Friesian, Boran and Bunaji calves have been published by Badran and El-Barbary (1986), Mpiri (1987) and Oni et al. (1988), respectively.

Table 3 shows that across year groups, the highest BWT of 32.9 kg was obtained in 1965-1969, while the least was recorded in 1985-1989. In a situation where both the amount and distribution of annual rainfall fluctuate greatly, such significant differences are expected (Oni et al., 1988). Climatic data revealed that between 1965 and 1969, mean annual rainfall was 1,316 mm as compared to 972 mm recorded between 1985 and 1989. The highest birth weight value therefore seems to be associated with high rainfall when abundant pasture must have been available to meet the nutritional requirements of the foetus for rapid growth during the last trimester of pregnancy.

TABLE 2. LEAST SQUARES MEANS (LSM) ± S.E. FOR GROWTH TRAITS (kg) ACROSS SEASONS OF BIRTH*

	BWT	WT3	WT6	WT9	WT12
Overall mean	26.7 ± 1.3	72.4 ± 4.5	112.9 ± 6.9	147.2 ± 9.2	182.1 ± 11.1
No. of records	(549)	(496)	(400)	(360)	(300)
Season of birth					
Dry	23.9ᵃ	74.5ᵃ	133.3ᵃ	148.2	176.4
Wet	27.3ᵇ	84.9ᵇ	105.8ᵇ	144.8	185.2
Harmattan	30.9ᶜ	57.7ᶜ	99.5ᶜ	148.7	184.7

* Differences between means with different superscripts within the same column are statistically significant ($p < 0.05$).
MOB = Month of birth,   SOB = Season of birth,   YOB = Year of birth,   BWT = Birth weight,   WT3 = Weight at 3 months of age,   WT6 = Weight at 6 months of age,   WT9 = Weight at 9 months of age,   WT12 = Weight at 12 months of age.

TABLE 3. LEAST SQUARES MEANS ± S.E. FOR GROWTH TRAITS (kg) ACROSS 5-YEARLY INTERVALS OF BIRTH*

	BWT	WT3	WT6	WT9	WT12
Overall mean	26.7 ± 1.3	72.4 ± 4.5	112.9 ± 6.9	147.2 ± 9.2	182.1 ± 11.1
No. of records	(549)	(496)	(400)	(360)	(300)
Year of birth					
1965-1969	32.9ᵃ	84.8ᵃ	134.3ᵃ	184.1ᵃ	202.0ᵃ
1970-1974	27.9ᵇ	80.2ᵇ	126.3ᵇ	164.21ᵇ	185.2ᵇ
1975-1979	26.5ᶜ	68.7ᶜ	122.1ᶜ	149.7ᶜ	184.7ᵇ
1980-1984	26.2ᶜ	69.1ᶜ	97.4ᵈ	130.7ᵈ	169.4ᶜ
1985-1989	17.5ᵈ	58.9ᵈ	87.2ᵉ	107.4ᵉ	132.4ᵈ

* Differences between means with different superscripts within the same column are statistically significant ($p < 0.05$).
Growth trait abbreviations as in tables 1 and 2.

Body weight at 3 months of age (WT3)

Table 1 shows that season and year of birth significantly affected WT3 ($p < 0.05$ and $p < 0.01$). Least squares means in tables 2 and 3 reveal that overall, WT3 averaged 72.4 ± 4.5 kg. This closely agrees with the findings of Johnson and Gambo (1975) and Ehoche et al. (1991) who reported mean values of 70.53 and 68.20 kg, respectively in Friesian × Bunaji calves.

WT3 was highest for calves born during the wet season as shown in table 2, probably due to the availability of abundant pasture, hence a high milk production by their dams. Alaku (1982) and Oni et al. (1988) also reported that body weight at 3 months of age was higher for Wadara and Bunaji calves respectively, born during the rainy season.

Across five-yearly intervals of birth (table 3), the highest value of 84.8 kg was obtained in the years 1965-1969. Year effects are indeed significant in determining the amount and distribution of pastures and other feed supplements. It appears that calves born within this year group carried over their initial weight advantage at birth right up to three months of age.

TABLE 4. PHENOTYPIC CORRELATIONS BETWEEN BODY WEIGHTS*

Traits	BWT	WT3	WT6	WT9	WT12
BWT	1.00				
WT3	0.61	1.00			
WT6	0.40	0.70	1.00		
WT9	0.38	0.55	0.74	1.00	
WT12	0.31	0.49	0.58	0.79	1.00

* All correlations were highly significant ($p < 0.01$).
Growth trait abbreviations as in tables 1 and 2.

Body weight at 6 months of age (WT6)

Table 1 shows that season and year of birth were significant ($p < 0.05$ and $p < 0.01$) sources of variation in affecting WT6. Similar reports have been published by Saha and Parekh (1988). Least squares means in table 2 and 3 show that overall, WT6 averaged 112.9 ± 6.9 kg. Cordeiro (1985) in his study of the effect of sex, month and year of calving on weights of Nellore cattle, reported a mean value of 110.86 kg at 6 months of age. Baik et al.

(1985) reported an average value of 110.7 kg in Korean cattle, while Slabkina and Denisova (1986) obtained an average of 112.8 kg at 6 months of age in Holstein-Friesian × Jersey heifers. The value obtained in this study falls within the range of these reports.

Calves born during the dry season had the highest WT6 of 133.3 kg (table 2), possibly because they were at this stage, able to utilise the flush of pasture growth that coincides with the onset of the rains (Carles and Rilley, 1984). Five-yearly interval classification in table 3, reveals that calves born in 1965-1969 still recorded the highest WT6 of 134.3 kg. Given their previous weight advantage, this superiority in body weight over the other years of calving conforms to expectation in the light of pasture quantity, quality and availability.

Body weight at 9 months of age (WT9)

Table 1 shows that season of birth did not affect WT9, but year of birth was a highly significant source of variation (p < 0.01). The non-significant effect of season is perhaps due to the fact that the calves were at this age advanced in growth and were therefore better able to storm the tide of seasonal variations.

Overall, WT9 averaged 147.2 ± 9.2 kg (tables 2 and 3) This agrees closely with the 270-day weight of Nellore calves reported by Cordeiro (1985), but lower than the 156.1 kg reported for Tabapua calves at the same age by Ledic et al. (1985). Such differences could be attributable to disparities in breed, management and number of records analysed.

Table 3 shows that across groups of years of calving, 1965-1969 was superior to the other groups in WT9 value. This indicates that the weight advantage noticed at 3 and 6 months of age was maintained up to 9 months of age.

Body weight at 12 months of age (WT12)

Table 1 shows that only year of birth significantly affected WT12 (p < 0.01). Overall, WT12 averaged 182.1 ± 11.1 kg (tables 2 and 3). In female progeny of crossbred cattle of the same age, Khedkar et al. (1985) reported a mean value of 188.93 kg in Brown Swiss × Zebu heifers. The value obtained in this study falls within the range reported in the foregoing. 1965-1969 still maintained the position of the heaviest calves with a mean value of 202.0 kg (table 3). This seems to agree with the report of Tawonezvi (1989) who observed that heavy calves at birth tend to maintain their growth advantage to later ages, in his study of the growth of Mashona cattle in Zimbabwe. On the other hand, this finding is contradicted by our seasonal data which showed that heifers born

during the harmattan season were heavier at birth than those born during the dry and wet seasons, but lost their superiority when they reached 9 months of age or more. There is a likelihood therefore, that heifers born in 1965-69 maintained their superiority to yearling age because the climatic or management conditions were more favourable than the other year of birth groups.

Phenotypic correlations

Table 4 shows the phenotypic correlations between body weights at birth, 3, 6, 9 and 12 months of age. They were all positive and highly significant (p < 0.01), ranging from 0.30 to 0.79. In a study establishing the growth patterns of dairy calves from birth to 90 days, El-Bushra et al. (1989) concluded that body weight at birth and thereafter are highly correlated. This has been confirmed in this study. The values obtained are in close agreement with the ranges reported by Venugopal et al. (1986) and Oni et al. (1989). The high correlation values of 0.70 between WT3 and WT6, 0.74 between WT6 and WT9, and 0.79 between WT9 and WT12 indicate that selection for yearling body weight can be done early on the basis of weights of heifers at 3 and 6 months of age.

Conclusion

From the results of this study, it can be concluded that the growth performance of Friesian × Bunaji halfbreds was significantly influenced by season and year of birth; it surpassed that of pure Bunaji breed and selection for growth can be based on body weights at 3 and 6 months of age.

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