

## PHENOTYPIC RELATIONSHIP BETWEEN BODY WEIGHTS AND SUBSEQUENT MILK PRODUCTION OF FRIESIAN-BUNAJI CROSSBREDS

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### SUMMARY

The study reported was conducted to investigate whether fast growing heifers eventually become good milkers in a bid to assist dairy farmers in selecting their replacement stock at an early age. The data analysed consisted of 549 body weight records at birth, 3, 6, 9 and 12 months of age of Friesian-Bunaji crossbred heifers, as well as 840 records on their subsequent lactation length, total lactation yield and estimated 305-day yield collected over a 23-year period (1967-1989).

Phenotypic correlations between body weights at fixed ages were all positive and highly significant ( $P < 0.01$ ), ranging from 0.30 to 0.79. Correlations among milk traits were also positive and highly significant, the range being 0.74 to 0.95. Correlations between body weights and milk traits on the other hand, were very low and non-significant, ranging from 0.01 to 0.14. Equations fitted from simple, multiple and polynomial regressions of body weights on total lactation yield gave very low  $R^2$  values. It was therefore concluded that body weights at birth, 3, 6 and 12 months of age have little value in the prediction of future milk yield of Friesian-Bunaji heifers.

*Keywords:* Friesian-Bunaji, body weight, milk, phenotypic, crossbred

### INTRODUCTION

It is desirable that farmers select their dairy replacement stock at an early age. This is to avoid costs of rearing subsequently unprofitable producers of milk. Dairy farmers are interested in knowing if heifers with higher growth rates also have higher milk yields.

Koul *et al.* (1985) and Roy and Marchand (1987) have reported significant phenotypic correlations between body weight at calving and the milk yield of cows, while Dim (1977), on the other hand, reported genetic correlations between performance test values for growth rate and breeding values for milk to be as low as 0.06. Whether measurements are taken at calving or during performance testing, the farmer would have had to wait for a long time before making a decision about replacement stock. The objective of this study is therefore to investigate the possibility of early decision-making by studying the phenotypic relationship between body weights of crossbred heifers from birth to yearling age, and their subsequent milk production.

### MATERIALS AND METHODS

#### *Location*

The data utilised for this study originated from the dairy herd of the National Animal Production Research Institute Shika, Zaria, Nigeria, located at 11°N and 12°E at an altitude of 640 m above sea level and within the guinea Savannah zone.

#### *Climatic conditions*

The average annual rainfall in this zone is 1100 mm, most of which falls during May to October. Peak rainfall is recorded during the wet season (June-September) when the relative humidity and daily temperature average 72% and 25°C, respectively. Following the wet season is a period of dry, cool weather called 'harmattan', which extends from mid-October to January. The dry season (February-May) is characterised by very hot weather conditions. During this period, daily temperatures range from 21°C to 36°C, while mean relative humidity is 21%.

#### *Breeding and management*

Crossbreeding of the Bunaji (White Fulani) cattle with Friesian commenced in 1964 using bulls imported from the United Kingdom. The mating plan and number of parents in each generation has been reported by Buvanendran *et al.* (1981). Artificial insemination using semen from ½ Friesian-Bunaji bulls on ½ Friesian-Bunaji cows was carried out in subsequent generations. Details of their numbers, dairy performance as well

as growth to yearling age have been published (Malau-Aduli *et al.* 1993a, 1993b). The animals were grazed during the rainy season on paddock-sown pastures, while hay or silage supplemented with concentrates of cottonseed cake, maize or guinea corn were offered during the dry season, when animals were housed in open sheds. They had access to salt-lick at all times. Regular spraying against ticks was done, and vaccinations against contagious diseases carried out. Calves were separated from their dams 3 days after birth and bucket-fed until 3 months of age when they were weaned. Their body weights were recorded at birth and monthly thereafter, while the cows were machine-milked twice daily.

*Statistical analyses*

The data analysed consisted of 549 body weight records at birth (BWT), and at 3 (WT6), 9 (WT9) and 12 (WT12) months of age of Friesian-Bunaji heifers, as well as 840 records on their subsequent lactation length (LL), total lactation yield (TLY) and estimated 305-day yield (305DY) collected over a 23-year period (1967-1989). The data were statistically adjusted for differences in season, parity and year of calving using additive correction factors derived from least squares constants in accordance with the procedures of Harvey (1990). Thereafter, phenotypic correlations between growth and milk traits were computed using the Pearson Correlation Module while tests of significance at 1 and 5% levels were carried out using the Bonferroni probabilities of SYSTAT (Wilkinson 1988). Simple and multiple regressions were fitted to predict milk yield from body weights.

**RESULTS AND DISCUSSION**

Phenotypic correlations among and between body weights and milk traits are shown in Table 1. Body weights at birth, 3, 6, 9 and 12 months of age were all positively and highly significantly correlated ( $P < 0.01$ ). This supports the findings of El-Bushra *et al.* (1989) who, in a study establishing the growth patterns of dairy calves from birth to 90 days, concluded that body weights at birth and thereafter are highly correlated. The highest correlation of 0.79 was between body weights at 9 months (WT9) and 12 months (WT12) of age, while the least value of 0.30 was between birth weight (BWT) and WT12. This seems to suggest that selection for yearling weights in Friesian-Bunaji heifers could best be reliably done on the basis of body weight at 9 months of age instead of birth weight. The correlation values obtained in this study are in close agreement with the ranges reported by Tilakaratne and Matsukawa (1983), Azevedo *et al.* (1986) and Venugopal *et al.* (1986).

**Table 1. Phenotypic correlations between body weights and milk traits**

| Traits <sup>A</sup> | LL     | TLY    | 305DY | BWT    | WT3    | WT6    | WT9    | WT12 |
|---------------------|--------|--------|-------|--------|--------|--------|--------|------|
| LL                  | 1.00   |        |       |        |        |        |        |      |
| TLY                 | 0.78** | 1.00   |       |        |        |        |        |      |
| 305DY               | 0.74   | 0.95** | 1.00  |        |        |        |        |      |
| BWT                 | 0.14   | 0.13   | 0.14  | 1.00   |        |        |        |      |
| WT3                 | 0.07   | 0.09   | 0.10  | 0.61** | 1.00   |        |        |      |
| WT6                 | 0.04   | 0.12   | 0.14  | 0.40** | 0.70** | 1.00   |        |      |
| WT9                 | 0.01   | 0.03   | 0.05  | 0.38** | 0.55** | 0.74** | 1.00   |      |
| WT12                | 0.02   | 0.01   | 0.06  | 0.30** | 0.49** | 0.58** | 0.79** | 1.00 |

\*\*  $P < 0.01$ .

- <sup>A</sup> LL = Lactation length.
- TLY = Total lactation yield.
- 305DY = 305-day yield.
- BWT = Birth weight.
- WT3 = Body weight at 3 months of age.
- WT6 = " " " 6 " "
- WT9 = " " " 9 " "
- WT12 = " " " 12 " "

All correlations among milk traits were also positive and highly significant ( $P < 0.01$ ). The highest correlation of 0.95 was between estimated 305-day yield (305DY) and total lactation yield (TLY). This high correlation is expected because 305DY was estimated from TLY (details in Malau-Aduli and Abubakar

1992). The correlation of 0.78 between TLY and lactation length (LL) agrees closely with the reports of 0.74 in Sahiwal (Sharma *et al.* 1987), but is lower than 0.86 obtained in Holstein-Friesian x Zebu (Polastre *et al.* 1987) and 0.99 in Guzera cows (Bastos 1989). It is generally known that on average, the longer the lactation length of a cow, the higher her lactation yield.

Phenotypic correlations between growth and milk traits were very low and non-significant, ranging from 0.01 to 0.14. Most studies (Plum *et al.* 1952; Holtz *et al.* 1961; Martin *et al.* 1962; Dim 1977) of the phenotypic and genetic correlations between growth rate of heifers and milk production show that they are positive but very low. This has been confirmed in this study. The implication of this is that the relationship between body weights from birth to yearling age and subsequent milk production of Friesian-Bunaji cows is not reliably strong enough for making any accurate predictions.

Table 2 shows simple and multiple regressions of TLY on body weights. The use of BWT, WT3, WT6, WT9 and WT12 for the prediction of TLY gave  $R^2$  values of 0.228, 0.103, 0.139, 0.158 and 0.168, respectively. Combinations of WT3 and WT6, WT9 and WT12 and WT6, WT9 and WT12 did not lead to any improvement in the  $R^2$  values, as these averaged 0.141, 0.163 and 0.236, respectively. The implication is that whether body weights at birth, 3, 6, 9 and 12 months of age are used singly or in combinations in estimating total lactation yield of Friesian-Bunaji crossbreds, the accuracy of such estimation is not improved. Polynomial regressions were fitted but without any improvement, hence the results are not tabulated. Wilk *et al.* (1963), Johansson (1964) and Tyler (1970) have all concluded that liveweights and body measurements of heifers at 6, 12, 18 and 24 months of age have little or no value for the prediction of future milk yield. The results of this study confirm their reports.

It can be concluded that the early selection of dairy heifers should not be done solely on the basis of their body weights from birth to yearling age, since fast growing heifers do not necessarily become good milkers.

**Table 2. Simple and multiple regressions of total lactation yield on body weights**

| Dependent variable | Intercept | Regression coefficients |              |              | $R^{2B}$ |
|--------------------|-----------|-------------------------|--------------|--------------|----------|
|                    |           | $b_1$                   | $b_2$        | $b_3$        |          |
| TLY <sup>A</sup>   | -1564.626 | 87.790 (Bwt)            | -            | -            | 0.228    |
|                    | -228.171  | 13.095 (Wt3)            | -            | -            | 0.103    |
|                    | -304.506  | 9.857 (Wt6)             | -            | -            | 0.139    |
|                    | -327.032  | 8.085 (Wt9)             | -            | -            | 0.158    |
|                    | -341.146  | 6.671 (Wt12)            | -            | -            | 0.168    |
|                    | -351.005  | 3.043 (Wt3)             | 8.304 (Wt6)  | -            | 0.141    |
|                    | -362.161  | 4.214 (Wt9)             | 3.406 (Wt12) | -            | 0.163    |
|                    | -371.212  | 3.675 (Wt6)             | 2.813 (Wt9)  | 1.912 (Wt12) | 0.236    |

<sup>A</sup> As in Table 1.

<sup>B</sup>  $R^2$  values were all non-significant ( $P > 0.05$ ).

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