ESTIMATES OF GENETIC AND PHENOTYPIC PARAMETERS FOR DAIRY TRAITS IN FRIESIAN-BUNAJI CROSSBREDS

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SUMMARY

Genetic and phenotypic parameters for dairy traits were computed using data on Friesian-Bunaji crossbred cows collected over a twenty-three year period (1967-1989) from the dairy herd of the National Animal Production Research Institute Shika, Zaria, Nigeria.

Estimated repeatabilities computed from variance components were 0.72 ± 0.06, 0.60 ± 0.10, 0.73 ± 0.02, 0.53 ± 0.24 and 0.56 ± 0.18 for total lactation yield, lactation length, 305-day yield, calving interval and dry period, respectively.

Heritability estimates were 0.44 ± 0.07, 0.52 ± 0.12, 0.30 ± 0.13, 0.18 ± 0.02, 0.26 ± 0.08 and 0.27 ± 0.10 for total lactation yield, lactation length, 305-day yield, calving interval, dry period and age at first calving, respectively.

Genetic and phenotypic correlation coefficients between traits were medium to high, ranging from 0.30 to 0.95. The results of this study showed that the genetic response to selection in Friesian-Bunaji crosses for total lactation yield, 305-day yield and lactation length could be moderately high since the proportion of additive genetic variance was fairly high. Improvement programmes for age at first calving, calving interval and dry period should focus mostly on management, given their low heritability estimates.

INTRODUCTION

To devise an efficient method of selection for genetic improvement in dairy cattle, it is necessary for breeders to have information on the heritability, repeatability, genetic and phenotypic correlations of dairy traits. In Nigeria, there are no published estimates of genetic parameters available for dairy traits in Friesian-Bunaji crossbreds. This is partly because genetic estimates are population attributes, and large numbers of animals with accurately recorded information are not easily available in the tropics (Oni et al. 1989). This study therefore attempts to estimate heritabilities, repeatabilities, genetic and phenotypic correlations of dairy traits in Friesian-Bunaji crossbreds.

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 between 11°N and 12°E at an altitude of 640 m above sea level 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 marks the onset of the dry season. This extends from mid-October to January. The dry season (February-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%.

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 1/2 Friesian-Bunaji bulls on 1/2 Friesian-Bunaji cows was carried out in subsequent generations.

The animals were raised during the rainy season on paddock-sown pastures, while hay or silage supplemented with 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 observed, while vaccinations against contagious diseases were carried out. Calves were separated from their dams three days after birth and bucket-fed until three months of age when they were weaned. The cows were machine-milked twice daily.

Statistical analyses

The data analysed consisted of 840 records on total lactation yield, 305-day yield (estimated as per Malau-Aduli and Abubakar 1992), lactation length, calving interval, dry period and age at first calving of 1/2 Friesian-Bunaji cows mated to 55 1/2 Friesian-Bunaji bulls over a twenty three year period. Because these data were obtained at different seasons, years and parities, they were statistically adjusted using additive correction factors derived from least-squares constants from the linear model: $Y_{ijkl} = \bullet + YC_i + SC_j + P_k + E_{ijkl}$

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

$\bullet$ = the overall mean

YC_i = fixed effect of the i^{th} year (i=1, 23)

SC_i = fixed effect of the j^{th} season (j=1, 3)

P_k = fixed effect of the k^{th} parity (k=1, 7)

E_{ijkl} = random error associated with each record with expectation 0, σ^2

Repeatabilities were estimated from variance components using Method 3 of Henderson (1953), employing the procedure described by Becker (1984): $r = \frac{\sigma^2_A}{\sigma^2_A + \sigma^2_E}$

where r = repeatability estimate

σ^2_A = animal variance component

σ^2_E = environmental variance component

Estimates of heritabilities, genetic and phenotypic correlations were obtained by the LSMLMW and MIXMMDL programmes of Harvey (1990).

RESULTS AND DISCUSSION

Table 1: Heritability (h^2) and repeatability (r) of dairy traits* (± S.E.)

Trait	h^2	r
TLY	0.44 ± 0.07	0.72 ± 0.06
LL	0.52 ± 0.12	0.60 ± 0.10
305DY	0.30 ± 0.13	0.73 ± 0.02
DDRY	0.26 ± 0.08	0.56 ± 0.18
AFC	0.27 ± 0.10	--------
CI	0.18 ± 0.02	0.53 ± 0.24

* TLY = Total lactation yield, LL = Lactation length, 305DY = 305-day yield, DDRY= dry period, AFC = Age at first calving, CI = Calving interval

Table 2 : Genetic and phenotypic correlations between dairy traits#

Trait@	LL	TLY	305DY	AFC	DDRY	CI
LL		0.71**	0.63**	0.15**	-0.07**	0.10
TLY	0.78**		0.89**	0.26*	-0.01	0.06
305DY	0.74**	0.95**		0.24*	-0.15	0.02
AFC	0.30*	0.35*	0.33*		0.08	0.01
DDRY	-0.12	-0.19*	-0.20*	0.16		0.22
CI	0.19	0.13	0.12	0.06	0.28	

@ As in Table 1

Genetic correlations are above the diagonal while phenotypic correlations are below. *P<0.05, ** P<0.01

Heritability estimates obtained for TLY, 305DY and LL were of medium to high values (0.30 - 0.52), but those of DDRY, AFC and CI were of low magnitude. The low heritability of calving interval, age at first calving and dry period indicates that response to selection for these traits will be minimal since the contribution of additive genetic variance is low. It also means that more attention would have to be given to environmental factors such as nutrition and management for instance, in improving the performance of cows with respect to these traits. On the other hand, medium to high heritability estimates obtained for 305-day yield, total lactation yield and lactation length are indicative of better genetic gain and progress if these traits are selected for in an improvement programme. The estimates of heritability obtained in this study agree with the range reported in the literature (Sharma et al. 1987; Ulusan and Ozcelik 1988; Reddy and Nagarcenkar 1989 and Pikash 1990)

Repeatability estimates as shown in Table 1, were generally high ranging from 0.53 to 0.73, with TLY and 305DY recording the highest estimates. This suggests that if Friesian-Bunaji cows are selected early on the basis of superior performance with respect to total lactation yield and 305-day yield, there is a likelihood within narrow confidence limits that this superiority will be re-exhibited later in life.

Genetic and phenotypic correlations between dairy traits are shown in Table 2. With the exception of calving interval, all other correlations between traits were significant ($P<0.05$, $P<0.01$). The highest estimate of 0.95 was obtained between 305DY and TLY, possibly because the former was estimated from the latter. The negative, low but significant ($P<0.05$) correlations between DDRY and LL, TLY and 305DY indicate antagonism between these traits.

In conclusion, the results of this study have shown that the genetic response to selection in Friesian-Bunaji crosses for total lactation yield, 305-day yield and lactation length could be moderately high, while improvement programmes for age at first calving, calving interval and dry period should focus mainly on management, given their low heritabilities.

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