What indigenous dairy breed to be crossed with Holstein-Friesian sires for milk production in the Sudan.

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SUMMARY

Local Sudanese dairy breeds, mainly Butana (BB) and Kenana (KK) and their Holstein-Friesian first crosses: Friesian x Butana (FB) and Friesian x Kenana (FK) were evaluated for their production and reproduction traits. The average (± se) lactation milk yield, 210 days milk yield, milk per day of lactation, milk per day of calving interval, lactation length, calving interval, and age at first calving for BB were 2031 ± 118 kg, 1528 82 kg, 7.3 ± 0.41 kg, 5.6 ± 0.51 kg, 287 ± 11 days, and 47.4 ± 2.5 months, respectively.

The corresponding values for KK were 1647 ± 67 kg, 1159 ± 47 kg, 5.5 ± 0.23 kg, 3.7+ 0.42 kg, 308 ± 6 days, 427 ± 10 days and 59.9 + 1.4 months, respectively. Butana breed was significantly (P<0.01) higher than KK in total lactation milk yield, 210 days milk yield, milk per day of lactation, milk per day of calving interval and shorter (P<0.05) in calving interval and calved the first time at a younger (P<0.05) age.

The crossbred cows showed superiority over their respective straightbreds. The average lactation milk yield, 210 days milk yield, milk per day of lactation, milk per day of calving interval, lactation length, calving interval, and age at first calving for FB were 4924 ± 243 kg, 3120 ± 166 kg, 4.9 ± 0.79 kg, 9.6 ± 3.99 kg, 338+ 19 days, 393 ± 72 days, and ' 23.7 ± 7.9 months, respectively. The corresponding estimates for FK were 4322 ± 153 kg, 2304 ± 371 kg, 14.9 ± 0.49 kg, 10.0 ± 0.72 kg, 293 ± 12" days, 414 ± 15 days and 24.5 ± 2.7 months, respectively.

FB cows were higher (P<0.01) in total lactation milk yield, 210 days milk yield, longer lactation and were shorter (P<0.05) in calving interval.

The heritability estimates for milk yield traits of the straightbreds ranged between 0.21 ± 0.12 and 0.44 ± 0.31 and for the crossbreds ranged between 0.33 + 0.25 and 0.55 + 0.42. Regardless of breed, the heritability estimates for reproduction traits were effectively zero. Butana and their Holstein crosses out-yielded Kenana and their crosses in many production and reproduction aspects.

INTRODUCTION

Generally, the indigenous breeds in developing countries produce relatively little milk and hence an immediate genetic improvement can often be made by the use of improved temperate breeds. High demand for milk and milk products has led to importation of *Bos taurus* dairy breeds to upgrade the local *Bos indicus stocks*. Crossing of breeds to utilize individual additive and maternal additive genetic breed effects plus heterosis has been practiced in many parts of the tropical and subtropical regions where the productivity of cattle is generally low. Crossbreeding have been made to combine the dairy characteristics of the temperate breeds with the characteristics of heat tolerance and disease resistance of Zebu cattle (Maule, 1953; Bhalnagar and Sharma, 1970; Vaccaro, 1973, Ageeb and Hillers, 1991). In Sudan, the average 265 day milk yield of first cross Friesain x Butana and Friesain x Kenana were reported as 1696 + 131 and 1783 ± 125 kg, respectively (Ageeb and Hillers, 1991). In Ethiopia, lactation milk yield of Arsi x Friesian was 1736 kg/348 days (Butcher and Freeman, 1968) and in Nigeria the lactation milk yield of White Fulani x Friesian was reported as 1304 kg/225 day (cited by Min, 1965). Generally, the lactation milk yield of the temperate crossbreds exceeded the yield of the straightbred cattle.

In Sudan, Butana and Kenana dairy breeds possess an excellent genetic material for milk production (McLaughlin, 1955; Ageeb and Hillers, 1991; Ageeb 2001), They are milk-beefwork breeds derived from the humpless African Shorthorn and the Asiatic (long-homed) Zebu (Payne, 1970). Crossbreeding in these breeds involving Holstein-Friesian sires is a general norm in central

Sudan. Little comparative studies have been made to investigate the potential breed of dam to be used with the Holstein-Friesian sires to improve lactation milk yield and" reduce age at first calving. Therefore, the present study was done to study and compare Butana and Kenana dams and their FI crossbred cows, resulted frotri. crossing with Holstein-Friesian sires, on performance traits. The primary objective was to identify the breed of dam, among the dairy breeds, with high probability to genetically improve milk production traits when crossed with Friesian sire in Sudan.

MATERIALS AND METHODS

Background:

The data were obtained during 1984-1996 from University of Khartoum Dairy Farm at Shambat. The closed herd was established during the early fifties and consisted of Kenana (KK) and Butana (BB) cows; they fornied the foundation of the herd. The crossbreeding programme was initiated to provide high-yielding cows for intensive dairy production around the Capital City. Semen of the Holstein-Friesian (FF,)ulls was obtained from the Artificial Insemination Unit of the Ministry of Animal Resources, Khartoum, to inseminate KK and BB cows to produce FI Friesian x Butana, (FB) and Friesian x Kenana, (FK). The cows were bred by artificial insemination (AI).

Cattle were maintained on irrigated pasture and the main forages fed *ad libitum* were Abu 70 (variety of sorghum), Berseem *(Medicago sativa)* and lubia *(Dolichus lablab)*. Grazing on crop residues such as sorghum stalks and harvest aftermath was allowed. Supplementary rations composed of sorghum grains, wheat bran, molasses, cotton seed cake, and common salt were provided for the milking cows during milking at about 2.5 kg plus 1.5 kg concentrate per 5.0 kg of milk produced. Milking was done twice a day, 12 hours apart.

Climate:

Khartoum has a semi-desert climate characterized by being very hot during the summer season (March — June) and by low rainfall (Figure 1). High temperatures during the day and cool nights are the common norms of the area. Three distinct seasons occur. (1) hot early summer (March to June), (2) rainy (June to October); and (3) dry winter (November to February).

Data analysis:

From the initial records (n = 2,145) of 351 animals, twenty-two abnormal records were eliminated. Lactation lengths of less than 60 days and greater than 1000 days were discarded, as were those from cows with missing identification, missing birth dates, or missing calving dates. Calving intervals of less than 270 days or greater than 650 days were also edited out. The final data set was 1,626 records used for evaluating the performance of the genotypes. Data on milk yield were available in the records as they had been accumulated (TMY) and as 'standardized to 210 days yield (210-d). Incomplete lactation terms (terminated because the cow died or sold while milking) were extended to 210 days using the ratios derived from completed lactation records (210-day) and partial lactation records for the same lactation. Milk yield per day of lactation (MPD) and the annualized milk yield (AMY), which equivalent to milk per day of calving interval, were computed by simple division. Lactation lengths , (LL), age at first calving (AFC) and calving interval (CI) were considered and were calculated from the records.

The model used to test the fixed effects was

$Y_{ijklm} = \mu + Yr_i + S_j + P_k +$ E_{ijklm}

Where Y_{ijklm} is the production (TMY, 210-d, MPD, AMY, LL, CI, AFC) trait of the mth cow, calved in the ith year, jth season; 11 is an unknown population mean, constant for all records; Yr; is the fixed effect associated with the ith year of calving (1984 — 96); Sj is the fixed effect associated with the jth season of birth (in case of AFCY / calving (3 seasons); **Pk** is the fixed effect of the **kth** parity (1-8 parities); GL, is the fixed effect of the /th genetic group (3 genotypes); and $e_u ki_m$ is a random residual associated with each record. The interaction effects were tested and the non-significant interactions were removed from the model; the year x season and parity x genotype interactions were removed during the analysis. The Duncan multiple, range test (SAS, 1988) was performed to compare the mean performances between the genotypes. When there were highly disproportionate numbers of observations in the mean groups, Fisher's LSD (Chew, 1977) was used as a confirming statistical test.

Estimation of variance components:

Within-genotype analysis was performed to estimate variance components.
The model used was

$$Y_{ijklm} = \mu + Yr_i + S_j + P_k + \quad E_{ijklm}$$

Where Y_{ijkirn} is the production record of the mth cow, a daughter of lth sire, calved in the ith year, jth season; 1.1 is an unknown population mean; Y_i is the fixed effect associated with the ith year; S_1 is the fixed effect of the jth season; Pk is the fixed effect of the kth parity; Sr, is the random effect of the lth sire; C_{mi} is an additional random effect associated with the mth daughter of the /th sire; and eijkin. is the random residual associated with each record.

Sri C_{mi} and eijklmn were distributed randomly and independently with zero means and variances:
S N (0, s) C N (0, Io^{-2} as) e $N(0,I6^2 e)$

These three random elements were assumed not to be correlated with each other. The mixed model procedure of SAS (1988) was also used for the statistical analysis to estimate the variance components for the production traits. At convergence of the solutions of the restricted maximum likelihood (REML) in SAS, the relevant variances were used to calculate heritabilities (h^2) and repeatabilities (r):

$h2$ 4 cy2 s 4(32 s cF2 cis ± 0_2 e)

*72 s (52 cis +20.2 e)
$r = (3^2 s + a^2 cis)$

The standard errors of these estimates were obtained using the formulae of Becker (1975).

RESULTS

Production Traits:

The raw means and standard deviations for milk yield traits, age at first calving (AFC), and calving interval (CI) are in Table 1. The magnitude of variation in the straightbreds was higher (CV > 40% for yield traits) compare to those in crossbreds (CV > 30%. Generally, less biological variation for the reproductive **traits** than that for production traits was observed in these cattle.

Total lactation milk yield (TMY):

The mean (corrected for the fixed effects) TMY for **the breeds** were 2031±243, and 4322±153 kg for Butana (BB), Kenana (KK), Friesian x Butana **(FB),** and Friesian x Kenana (FK), respectively (Table 3). The lactation milk yield of the crossbred cows exceeded (p<0.01) the straightbreds. Among the straightbreds, **BB** produced more (p<0.01) milk than K.K. and among the crossbreds, **FB** produced more (p<0.01) than FK (Figure 2).

The environmental factors that influenced the variation in TMY were year of calving (p<0.001), season (p<0.05), and parity (p<0.001). Years of low rainfall, which influenced feed supply, had low TMY and cows that calved during the rainy season had high milk yield. Because the energy supply is partitioned between milk yield and growth at younger ages earlier parities had low TMY compared to later parities. Adjustment of records for these fixed effects is crucial for comparative studies.

Standardized milk yield (210-d):

Shorter lactation lengths are expected in Zebu cattle. Milk yield records were, therefore, standardized to 210 days instead of 305 days used for temperate cattle. The corrected average 210-d was 1528±82 kg for **BB,** 1159±47 kg for KK, 3120±166 kg for FB, and 2304±371 kg for FK (Table 3). The breed difference, parity, and year of calving were significant (p<0.001) for 210-d but season had no effect (p>0.05) (Table 2).

Milk yield per day of lactation (MPD):

The variation in MPD was influenced by the same factors as standardized 210-day milk yield (Table 2). The corrected mean MPD for the straightbreds were 7.3±41 and 5.5±0.23 kg for BB and KK, respectively: the breed difference was significant (P<0.001). Butana breed produced more MPD than Kenana. The average MPD for the crossbred were 14.9±0.79 and 14.9±0.49 kg, respectively (P<0.001) higher in the crossbreds than that in the purebreds (Table 3).

Milk per day of calving interval (AMY):

This trait, which is also known as the annualized milk yield (when AMY x 365 days), is considered an economic measure of milk yield based on calving interval. The corrected mean AMY for the breeds were 5.6±0.51, 3.7±0.42, 9.6±3.39, and 10.0±0.72 kg for **BB. KK,** FB and FK, respectively. Butana had higher (p<0.05) AMY compared to K.K. but between the crossbreds, the breed difference was not significant (P>0.05). Clearly, the crossbreds out-yielded (P<0.001) the straightbred breeds (Table 3). The variation in this trait was mainly influenced by breed (P<0.001) and year of calving (P<0.001) (Table 2).

Lactation length (LL):

The average corrected LL for the breeds were 283±11, 308±6, 338±19, and 293±12 days for BB, KK, FB, and FK, respectively (Table 3). The longest (P<0.001) lactation was maintained by BB, and between the other breeds the differences in LL were small (P>0.05). Breed (P<0.001), year of calving (P<0.001), and season of calving (P<0.05) were the main factors shown to influence the variation in LL in this study (Table 2). Late breeding of high-yield cows was not practiced at the farm, so the average LL in the herd was not be considered overestimated.

Reproduction:

Age at first calving (AFC): -

The corrected mean AFC of the straightbreds BB and KK were 47.4±2.5 and 59.9±1.4 months, respectively, with significant difference (P<0.001) between the two breeds (Table 3). Year of birth had a significant influence (P<0.01) on

AFC but season had no effects (P>0.05) (Table 2). Older ages at first calving were associated with years of poor management and insufficient feed supply.

Significant (P<0.01) reduction in AFC was recorded for the crossbred cows in comparison to their respective straightbreds. The average AFC for FB and FK were 23.7±7.9 and 24.5±2.7 months, respectively, the difference between the' crossbred was not significant (P>0.05). The differences in .AFC between the different genotypes were depicted in figure 3.

Calving interval (CI):

The average CI of the straightbreds were 403±12 and 427±10 days for BB and KK respectively, with no breed difference (P>0.05). The average CI of the crossbreds were 393±72 and 414±15 months for FB and FK, respectively, with no breed difference (P>0.05). However, FB cows had the shortest (p<0.01) CI in the herd (Table 3). The variation in CI was influenced by breed (P<0.01), parity (P<0.01), and year and season of calving (P<0.05); these factors mainly influenced oestrus and conception rates. Cows in this herd calved at a longer interval in later parities, in years of poor feed and unfavorable management practices, and in the dry seasons of the year.

Table 1. Number of records (n), raw means, standard deviations (SD) and coefficients of variation (CV%) of total lactation milk yield (TMY), 210-days yield (210-d), milk per day of lactation (MPD), lactation length (LL), age at first calving (AFC), calving interval (CI), and milk per day of calving interval (AMY) by genotype.

	Trait						
Genotype	TMY (kg)	210-d (kg)	MPD (kg)	LL (days)	AFC (mon.)	CI (days)	AMY (kg)
Butana B (B)							
n	211	211	211	211	47	198	166
Mean	2008	1438	6.9	295	49	494	5.7
SD	977	618	3.3	119	12	192	2.2
CV%	48.7	42.9	47.8	40.3	24.5	38.9	38:6
Kenana K (K)							
n	1056	1056	1056	1056	233	947	828
Mean	1695	1270	6.0	289	57	467	5.2
SD	776	580	2.5	92	16	133	2.2
CV%	45,8	45.7	41.2	31.8	28.1	28.5	42.3
Fl Friesian x Butana F (B)							
n	150	150	150	150	119	141	132
Mean	3460	2281	109	304	42	467	8..0
SD	1142	808	4.9	85	12	157	3.2
CV%	33.0	35.4	44.9	27.9	28.6	33.6	40.0
Fl Friesian x Kenana F (K)							
n	209	209	209	209	68'	133	130
Mean	3709	2777	13.2	288	39	498	7.6
SD	1079	807	6.1	97	13	118	3.3
CV%	29.1	29.1	46.2	33.7	33.3	23.7	43.4

Table 2. F values from ANOVA and the level of significance of the factors that influenced production traits 1· and age at first calving.

Source t	d.f.	TMY (kg)	210-d (kg)	MPD (kg)	LL (days)	CI (days)	AMY (kg)	AFC (mon.)
Genotype	3	45.5***	50.7***	51.6***	3.41***	2.80***	17.9***	17.2**
Year	11	3.46**	4.20*	4.20*	3.35*	1.57	3.00	5.90
Season	2	3.21*	0.24	0.24	4.05*	2.71*	0.05	0.31
Parity	7	5.23	6.05	6.05***	1.30	2.61	1.65	---

t Refer to Table (1) for the explanation of the abbreviations of production trait.
t The year and season are for calving for production traits and year and season of birth for age at first calving.
*** P<0.001; ** P<0.001; * P<0.05).

Table 3. Least-squares means (± standard error) of total lactation milk yield (TMY), 210 day milk yield (210-d), milk per day of lactation (MPD), milk per day of calving interval (AMY), calving interval (CI), lactation length (LL), and age at first calving (AFC) of Butana (BB), Kenana (KK) and their Holstein-Friesian crosses (FB, FK).

Breed	TMY (kg)	210-d (kg)	MPD (kg)	AMY (kg)	LL (days)	CI (days)	AFC (mon.)
B(B)	2031	1528	7.3	5.6	283	403	47.4
	±118^{a}	±82^{a}.	±0.41^{a}	±0.51^{a}	+11^{a}	+12^{a}	± 2.5^{a}
K(K)	1647	1159	5.5	3.7	308.	427	59.9
	±67^{b}	**±47^{b}**	**±0.23^{b}**	**0.421**	**±6a**	**±10^{b}**	**f 1.4^{b}**
F(B)	4924	3120	14.9	9.6	338	339	23.7
	±243^{c}	±166^{c}	±0.79^{c}	±3.99^{c}	±19^{b}	±72^{c}	±
F(K)	4322	2304	14.9	10.0	293	414	24.5
	±153^{d}	±371^{d}	±0.49^{c}	±0.72^{c}	+12^{a}	+15a^{b}	

a, **b, c, d,** within a breed, means within a column having a superscript in common are not significantly different (P>0.05).

Table 4. Heritability ($h^2 \pm$ SE) and repeatability (r ± SE) of milk production traits of Butana and Kenana cows and their Holstein Friesian crosses.

Genotype	Trait	h^2	r
BB			
	Total lactation milk yield (TMY)	**0.31±0.20**	**0.20±0.13**
	210 days milk yield (210-d)	**0.21±0.12**	**0.58±0.14**
	Milk per day of lactation (MPD)	**0.31±0.28**	**0.30±0.13**
	Lactation length (LL)	**0.08±0.10**	**0.33±0.12**
	Calving interval (CI)	**0.00**	**0.00**
	Milk per day of calving interval (AMY)	**0.19±0.14**	**0.28±0.12**
	Age at first calving (AFC)	**0.00**	**0.19±0.12**
KK			
	Total lactation milk yield (TMY)	**0.44±0.31**	**0.47±0.14**
	210 days milk yield (210-d)	**0. 33±0. 13**	**0. 36±0. 13**
	Milk per day of lactation (MPD)	**0.41±0.22**	**0.64±0.14**
	Lactation length (LL)	**0.46±0.25**	**0.35±0.21**
	Calving interval (CI)	**0.00**	**0.00**
	Milk per day of calving interval (AMY)	**0.16±0.10**	**0. 26±0. 14**
	Age at first calving (AFC)	**0.00**	**0.20±0.13**
FB			
	Total lactation milk yield (TMY)	**0. 55±0. 42**	**0.75±0.35**
	210 days milk yield (210-d)	**0.53±0.35**	**0.83±0.39**
	Milk per day of lactation (MPD)	**0.53±0.33**	**0.83±0.41**
	Lactation length (LL)	**0.16±0.21**	**0.21±0. 20**
	Calving interval (CI)	**0.00**	**0.02±0.01**
	Milk per day of calving interval (AMY)	**0.19±0.12**	**0.49±0.25**
	Age at first calving (AFC)	**0.00**	**0.19±0.16**
FK			
	Total lactation milk yield (TMY)	**0.66±0.27**	**0.39±0.12**
	Adjusted milk yield (305-d)	**0.38±0.31**	**0.49±0.13**
	Milk per day of lactation (MPD)	**0. 38±0. 25**	**0. 49±0. 13**
	Lactation length (LL)	**0.11±0.10**	**0.18±0.12**
	Calving interval (CI)	**0.00**	**0.00**
	Milk per day of calving interval (AMY)	**0.17±0.15**	**0.04±0.12**
	Age at first calving (AFC)	**0.00**	**0.31±0.14**

Estimation of genetic parameters:

The magnitude of genetic variation for milk production traits in the herd under study is relatively high especially in the crossbreds. The estimates of heritability (h^2) for milk yield traits for BB ranged between 0.21+0.12 and 0.31+0.30, and for Kenana ranged between 0.33+0.13 and 0.44+0.31. The h^2 of AMY was low and ranged between 0.16+0.21 and 0.19+0.14 in the straightbreds. The h^2 of lactation length fluctuated between the breeds and was estimated as 0.08+0.10 for BB and 0.46+0.25 for KK. The heritability estimates for the reproduction traits (CI, AFC) were effectively zero.

For the crossbreds, the h^2 estimates for milk yield traits ranged between 0.53+0.33 and 0.55+0.42 for FB and between 0.33+0.25 and 0.66+0.27 for FK. The h^2 of AMY for FB was 0.19+0.12 and for FK was 0.17+0.15. The h^2 of lactation length for FB and FK were 0.16+0.21 and 0.11+0.10 respectively. As for the straightbreds, the estimates of h^2 for reproductive traits for the crossbreds were also zero. The repeatability estimates were higher than their respective heritabilities for most traits; they showed the upper limit of the h^2 estimates.

DISCUSSION

Production traits:

The average lactation milk yield of BB and KK breeds were not different than the literature averages. Average lactation milk yield of 1465 and 1344 kg / 305-d for BB and KK, respectively, were reported by Ageeb and Hillers (1991) and 1597 kg / 265-d for Kenana reported by Wilson *et al.* (1987) and 2150 kg / annum for Butana reported by Osman and Russell (1974). However, the lactation milk yield may be higher than most indigenous African dairy breeds. Butana significantly produced more lactation milk yield and more milk per day of calving interval. This may indicate that Butana cows are economically more important for dairy farming than Kenana if lactation milk yield and age at first calving are taken into consideration. Friesian crosses showed superiority over the straightbreds in production and reproduction; this could be mainly due to individual additive and maternal additive genetic breed effects and heterosis. The great volume of milk produced by FB over FK is due to longer lactation length of the former and a superior breed of dam. The magnitude of heterosis can not be estimated, in this study, sue to the lack of production records of Ham-Friesian cows in Sudan. However, net heterozygosity of 616 kg was reported in crosses involved temperate and Zebu cattle in Kenya (Mackinnon *et al.* 1996). It is widely accepted that the wider the genetic distance or the greater the phenotypic differences between the parental breeds, the greater the heterosis expressed. Other environmental factors, such as ambient temperature, can significantly influence milk yield of the crossbreds due to the temperate genes incorporated in their genetic make-up. The effect of temperature on lactation milk yield was shown in Figure 4. Generally, Friesian **x** Butana was more sensitive to seasons of high temperatures (may — June) than Friesian x Kenana. Nevertheless, the influence of temperature on yield of different breeds can be addressed by different ways; the most practical one is rectal temperature as *a* measure of heat tolerance. Measures of rectal temperatures could **be** used with production records in selection indices.

Reproductive traits:

Not only that Butana cows produced more milk compared to Kenana, but also they calved at a younger age and have shorter intervals between calving. Obviously, these traits are having **an** economic implication and an advantage in favour of Butana breed. These results are not different than the results reported by **Ageeb** and Hillers (1991) except their finding in calving interval, which was shown to be similar between the two breeds. However, differences in numbers of observations and in location may **explain** these differences. The calving interval of Kenana_ in this study, **is** less than 530 days calving interval of Kenana reported **by** Wilson *et al.* (1987).

Between the crossbred cows, no difference in age at **first** calving of heifers was detected. This could be explained **by differences** in expression of heterosis and the influence **of** maternal effects. A similar calving interval between FB and FK was reported before (Ageeb and Hillers, 1991); this contradicts the results in the present study.

Heritabilities and repeatabilities:

The heritability estimates of milk yield traits were in agreement with most report in the literature. However, because of the small sample size and the average numbers of progeny per sire, which were only 3.5, 4.7, 3.0 and 3.6 daughters for **BB, KK, FB and FK, respectively, caution has to be** exercised in dealing with **these** estimates. The lower heritability estimate for milk yield per day of calving interval may result from the small sample size or may be due to the extreme environmental conditions.

Tropical dairy records have, in most cases, featured paucity and limited volumes of records. Records structure of as few as one daughter per sire have been used in genetic studieS and evaluation. Schneeberger *et al*. (1982) used a minimum of 5 daughters per sire in evaluating Jamaica Hope sires. They reported small differences in breeding values between sires. However, ranking of sires is greatly influenced by the number of progeny per sire. in essence, estimation of genetic parameters of milk production traits requires large number of daughters per sire, accommodation of the relationships matrix among animals and separation of sires into young (random progeny testing sires) and proven (old proven) sires to reduce bias due to selection. Ignoring the additive relationships among animals in the model of analysis may result in some residuals be correlated with each other and this in turn may lead to underestimation of error variance and therefore, the test of significance of the effects may be biased upward. The use of first lactation records in estimation of genetic parameters reduces bias due to intensive selection anticipated after the first lactation and generates different estimates than using all the records. Higher heritability estimates for heifers (first lactation records) over the cows (all records) for milk production traits were reported in dairy cattle in the tropics (Ageeb and Hayes, 2000). The heritability estimates of reproductive traits were similar to most values in the literature. Ageeb and Hayes (2000) also reported zero heritability for days from calving to first oestrus, days from calving to conception and calving interval for temperate cattle in the Sudan.

CONCLUSIONS

The small sample size and spanning of records over few years may make conclusions difficult. Nonetheless, Butana breed has shown to be superior to Kenana in milk yield, age at first calving and calving interval. They are traits of economic importance in _dairy industry. Holstein-Friesian crosses showed superiority over their respective straightbreds. However, Friesian x Butana cows exceeded Friesian x Kenana in lactation milk yield, lactation length and shorter in calving interval. In conclusion, Butana breed is most likely better than Kenana as dairy breed. 'Also, Butana cows are

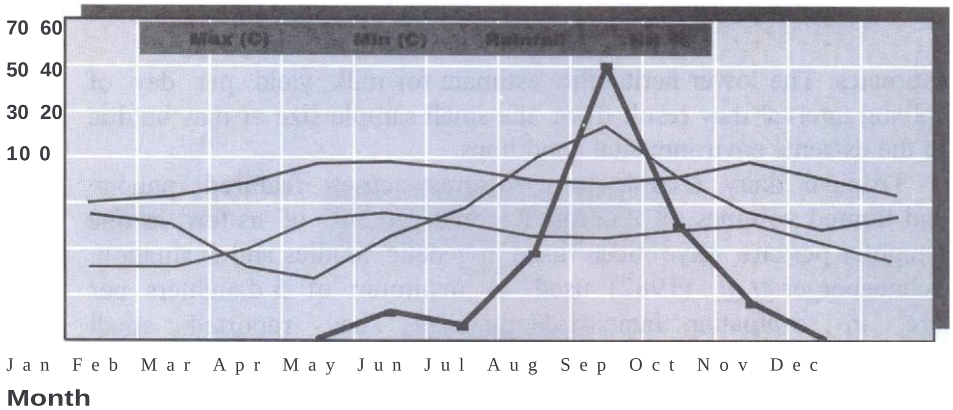

Figure 1. Monthly temperatures (maximum, minimum), rainfall (mm) and relative humidity (RH) for Khartoum in 1985 -96

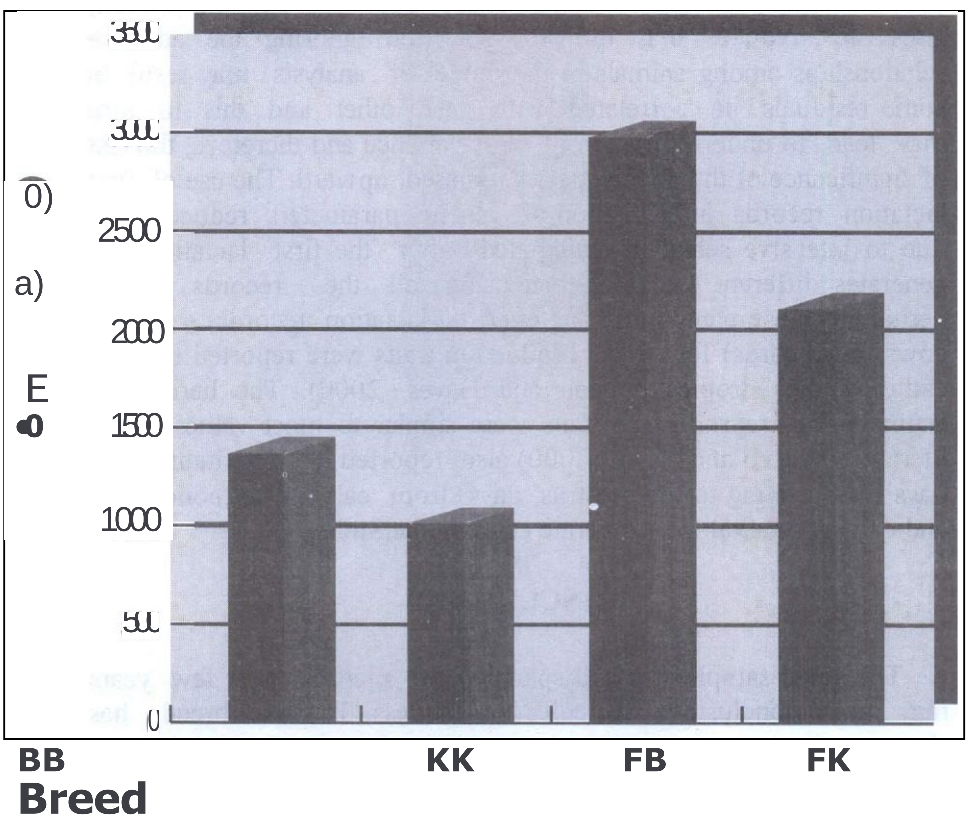

Figure 2. The average corrected lactation milk yield by breed

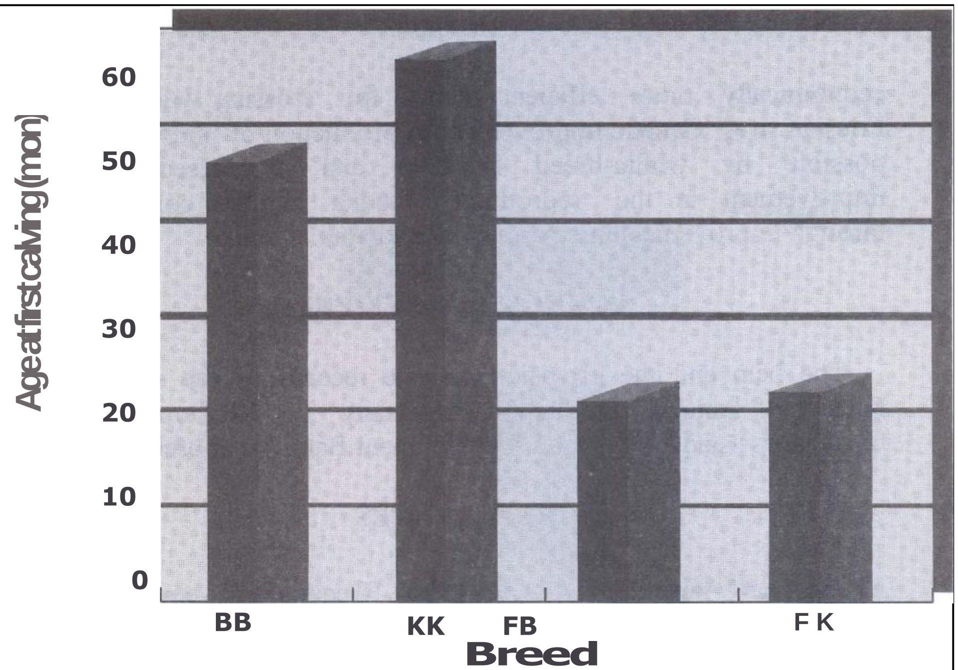

Figure 3. Age at first calving of the breeds

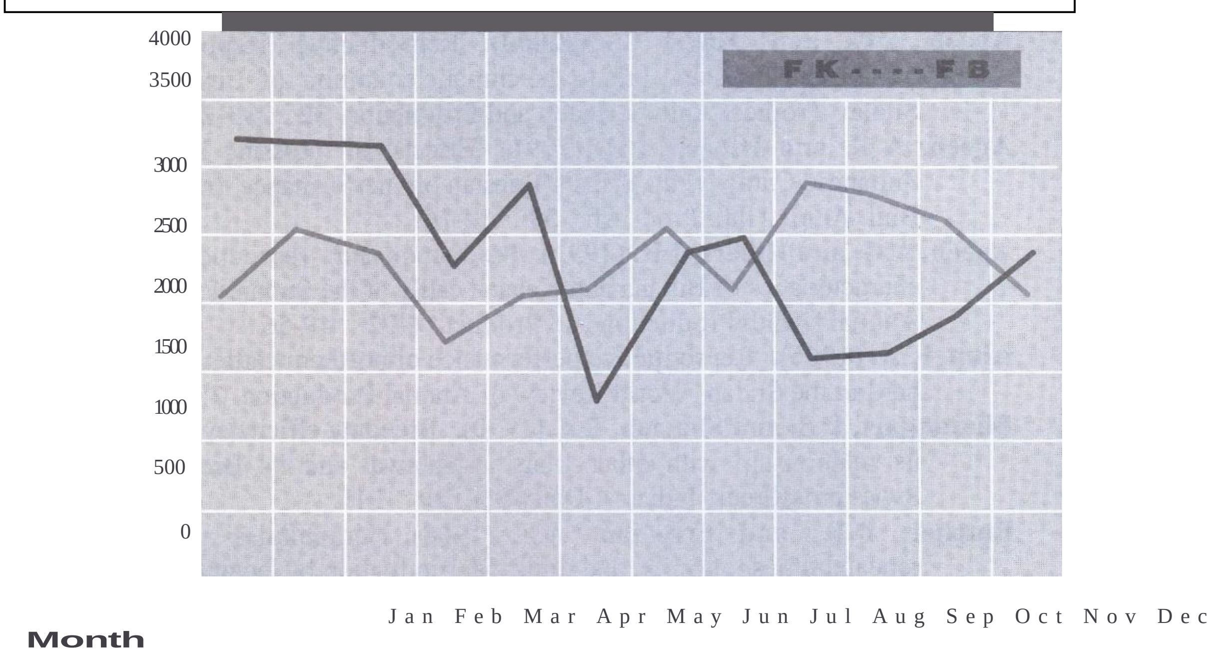

Figure 4. Lactation milk yield of Friesian x Butana and Friesian x Kenana cattle in months of the year.

economically more efficient dams for crossing with Holstein-Friesian sires. Genetic improvement in production of these breeds is possible by within-breed selection and crossbreeding while improvement in the reproductive traits could come about through improvement in environmental factors.

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REFERENCES

Ageeb, A.G. and Hayes, J.F. (2000). Genetic and environmental effects on the productivity of Holstein-Friesian cattle **under** the climatic condition of Central Sudan. Tropical Animal Health and Production, **32 :** 33-49.

Ageeb, A.G. (2001). Crossbreeding effects between two Sudanese dairy breeds for milk production traits. (unpublished).

Ageeb, A.G. and Hayes, J.F. (2000). Reproductive responses of Holstein-Friesian cattle to the climatic condition of Central Sudan. Tropical Animal Health and Production, **32 :** 233-243.

Ageeb, A.G. and Hillers, J.K. (1991). Effects of crossing local Sudanese Cattle with British Friesian on performance traits. Bull. Anim. Hith. Prod. Afr., **39 :** 69-76.

Ageeb, A.G. and Hillers, J.K. (1991). Production and reproduction characteristics of Butana and Kenana cattle of the Sudan. FAO Animal Health Production and Product, **67/2:** 49-56.

Alim, K.A. (1965). Reproductive performance of northern cattle in a herd in the Sudan. World Review of Animal Production. **2:** 49.

Bhatangart, D.S. and Sharma, R.C.(1970). Breeding efficiency and its relationship with other traits in Sahiwal and its Brown Swiss crossbreds. Indian **J.** Dairy Sci., **29 :** 141.

Butcher, D.F. and Freeman, A.E. (1968).. Heritabilities and repeatabilities of milk and milk fat production by lactations. J. Dairy Sci., **51 :** 1387.

Mackinnon, M.J., Thorpe, W. and Baker, R.I. (1996). Sources of genetic variation for milk production in a crossbred herd in the tropics. Animal Science. **62 :** 5-16.

Maule, J.P. (1953). Crossbreeding experiments with dairy cattle in the tropics. Anim. Breed. Abstr., **21 :** 105.

McLaughlin, E.A. (1955). The cattle of the Fung: A local variant of the Short-homed zebu, indigenous to the northern Sudan. Empire J. Experimental Agriculture, **23 :** 188-210.

Osman, A.H. and Russel, W.S. (1974). Comparative performance of different grades of European-Zebu crossbred cattle at Ghurashi Dairy Farm. Sudan Tropical Agriculture (Trinidad), **51 :** 549-558.

Payne, W.J.A. (1970). Cattle Production in the Tropics. Vol. 1, Longman Group Ltd., London.

SAS, (1988). SAS / STAT User's Guide Release 6.03 edition, (SAS Institute Inc., Cary, NC).

Schneeberger, C.R., Wellington, K.E. and McDowell, R.E. (1982). Performance of Jamaica Hope cattle in commercial dairy herds in Jamaica. J. Dairy Sci., **65 :** 1364-1371.

Vaccaro, L. (1973). Some aspects of the performance of purebred and crossbred dairy cattle in the tropics. Anim. Breed. Abstr., **41 :** 571.

Wilson, R.T., Ward, P.N., Saeed, A.M. and Light, D. (1987). Milk production characteristics of Kenana breed of Bos indicus cattle in Sudan. J. Dairy Sci., 70 : 2673-2679.

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أنسب السلالات السودانية التي يمكن تهجينها مع فصيلة الهولستاين فريزيان لإنتاج الألبان في السودان

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ملخص البحث :

تهدف هذه الدراسة التي تقييم الصفات التناسلية وانتاج الألبان لفصائل الأبقار السودانية من الكنانة و البطانة مع شجاذها من الفريزيان ، هذه الصفات هي : متوسط إنتاج اللبن في الموسم الذي طوله) 21 يوم ، إنتاج اللبن العوسي الفترة بين و لأشتين ، طول موعده الحليب ، الفترة بين ولانتين والعصر عند أول ولادة إنتاج اللبن اليومي هذه المواصفات كانت الأبقار البطانة كما يأتي : 1131 = 118 كجم 1528 = 82 كجم ، F7.41 3 , كجم : 6 , 5 + 51 كجم : 11 t287يوم ، 13 4 + 12 يومر 2,547,4 شهر علي التوالي ، ولأبقار الكنانة كانت كما يلي : 637 | 63 كجم (1509 4741 كجم ، 5 ر 13 23 كجم ، 423,7 جم پوش 11137 بوم تي , 1,415 شهر علي التوالي فصيلة أبقار البطانة سجلت فروقات بمعنوية أعلي من فصيلة أبقار الكنانة 1) (P3 جملة إنتاج اللبن في الموسم ، طوني عرسهم الحليب (21 بود) ، كمية إنتاج اللبن في اليوم ، كمية اللبن في اليوم عقارية في الفترة بين ولادتيں ، قصر الفترة بين ولادتين) 0.05 (P > ، كما وأن أبقار البطانة كنت أصغر معنا في العمر عن أول ولادة أظهرت الأبقار الهجين نتائج أعلي من الفصائل المحلية في كسية إنتاج اللبن في الموسم 4 جملة إنتاج اللبن في 21 يوم ، متوسط إنتاج النبي في اليوم ، إنتاج اللبن في اليوم في الفترة بين ونتين ، طول سوسمع إنتاج الث ، الفترة من ولادتبري والعمر عند أول ولادة . سجلات هجين البطانة كانت 424 + 243 كج (3120 = 16) | كجد 76149 كجم 1965 1949 3 كجم ، 338 19 يوم ، 72393 پروم و 7,237 شهر علي التوالي . أما هجين الكنانة فقد كان : 1322 153 كجم 114 23-371 كجم ، (44,6 | 49 كجم ،) 1 32 كجم ، 293 12 بوم ، 414 + 15 يوم و 2,324 شهر علي التوالي ، سجل هجين البطانة نتائج أعلي من هجين الثقافة) 0.05 (P = في كمية اللبن المنتجة في الموسم ، كسية اللبن المنتجة في 21 يوم طول الحليب عدد أيام أقل للفترة بين ولانتين) 0.05 (P > تقدير المكافيء الوراثي للكدانة و البطانة الإنتاج اللبن بنحصر بيں) 12.21 ، و 44 (, 3 ! k , أما الهجين فينحصر بين (33 25 ، و 424,55 ,) آبما كان نوع الفصيلة فإن تقدير المكافيء الوراثي للصفات التناسلية يفتر بلا شيء