PRODUCTIVITY OF CROSS-BRED ZEBU CATTLE WITH DIFFERENT LEVELS OF FRIESIAN BLOOD

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SUMMARY

One hundred and nine, fourteen and ten first parity Friesian X Zebu cross-bred cows having respectively 50%, 62.5% and 75% Friesian blood were used. Most of the cross~breds were from Kenana dams and few were from Butana. All the 50% and 75% cross-breds were from the Nisheishiba Farm while all the 62.5% cross-breds were from the Univer- sity of Khartoum Experimental Farm. The objectives of the research were to study the effect of percent of Friesian blood, age, year and season of calving on productivity of cross-bred cows, and to determine the relation- ship among these productivity traits. Lactation yield and lactation length were highly significantly ($P < 0.01$) affected by percent of Friesian blood. Lactation yield was the only trait to be significantly ($p < 0.05$) affected by the age covariate. Both lactation yield and lactation length showed no clear seasonal or yearly trend. Daily milk yield and age at first calving were not significantly affected by any of the factors studied. Lactation yield had significant ($P < 0.05$) positive correlation with lactation length. The values of those correlations were 0.78, 0.60 and 0.94 for the 50%, 62.5% and 75% cross-breds respectively. Lactation yield was also highly positively correlated with daily milk yield with values ranging from 0.77 to 0.84. Lactation yield however, was lowly correlated with age at first calving. The correlation of lactation length was low with daily milk yield and not significant with age at first calving. The correlation between daily milk yield and age at first calving was positive for the 50% (0.15) and 75% (0.82) but negative for the 62.5% (- 0.48) cross-bred cows. Based on the results of this study it is suggested that the 50% Friesian blood would be the grade of choice under the Sudan tropical condition.

INTROCUCION

Genetic and environmental make u are two arameters which have . . .9 . P high effect on cattle production. By improving these two components, production can be increased a great deal. The indigenous Bos indicus breeds have higher level of overall adaptation to the environmental stress- es than the introduced Bos taurus (Simpson and Evangelou, 1983). Re- sponse capablilty for milk production is generally low in most breeds of indigenous cattle even when the environmental stresses are alleviated. As with many cattle in the tropics Sudanese indigenous cattle have an ex- tremely low milk production. The average annual milk yield of unim- proved indigenous stock, which form the majority of Sudanese cattle pro- duction, does not exceed 200 litres which is about one twentieth of that in several developed countries in Europe (Osman and Russel, 1974). The reasons for this low production are notably the unfavourable condition, low standards of animal husbandary pertaining to diseases, malnutrition and] or poor management as well as low genetic potential of the stock (Osman and Russel, 1974). Many breeds of the introduced Bos mums cattle have the additive ge- netic merit to respond for milk production when environmental stresses are minimal (Simpson and Evangelou, 1983). The challenge in the use of crossbreeding systems is to optimize the simultaneous use of both addi- tive (breed differences) and non-additive (heterosis) sources of genetic variation (Simpson and Evangelou, 1983). Many reports in the literature have demonstrated the advantage of crossing European dairy cattle with the indigenous breeds (Cunningham and Syrstad, 1987). However the performance of the different grades of cross-breds vary from one environment to another. The majority of re- ports indicate the suitability of 50% European blood for tropical condi- tions (Osman and Russel, 1974). The latter workers analyzed the perfor- mance of different grades of European-Zebu cross-bred cattle at Ghurashi Dairy Farm in the northem part of the Sudan and reported that the total lifetime milk yield increased with percentage of European blood to a max- imum of 75%. High grade cows also had high milk yield per year of pro- ductive

life, but a shorter total productive life and higher death rates and infertility problems. It was suggested that the 50% European blood would be suitable for Sudan tropical environment so long as they are pro- vided with suitable management and good environmental condition. In this study crossing was between Friesian and Sudan Kenana type resulting in 50%, 62.5% and 75% Friesian cross-breds. The specific ob- jectives of this study were: 1- To study the effect of percent of Friesian blood and year of calving on lactation yield, lactation length, daily milk yield and age at first calv- mg. 2- To determine the effect of age at first calving on lactation yield, lacta- tion length and daily milk yield. 3. Finally to determine the relationship among lactation yield, lactation length, daily milk yield and age at first calving for each cross.

MATERIALS AND METHODS

Data." The data used were first lactation milk records from cross-bred cows having 50%, 62.5% and 75% Friesian blood. The number of cows were respectively 109, 14 and 10. These data were collected from the Univer- sity of Gezira Farm at Nisheishiba (50% and 75% cross-breds) Universi- ty of Khartoum Farm. at Shambat (62.5% Friesian cross-breds). These data covered the period from 1979 to 1987. The traits studied were lacta- tion yield, lactation length, daily milk yield and age at first calving. Cow identification number (ID), sire ID, cow date of birth, cow date of calv- ing and cow percent of Friesian blood were recorded. The four traits measured were analyzed using the following fixed ef- fect multiple regression model:

observation = Mean + effect of age
+ effect of percent of Friesian blood
+ effect of season of calving
+ effect of year of calving ,
+ random error

The age of calving was used as a covariate in this model. The percents of Friesian blood were namely 50%, 62.5% and 75%. The seasons used

were winter (November to February), Summer (March to June) and autumn (July to October). There were nine years extending from 1979 to 1987.

After fitting the above model the following statistics were computed:

i) the average of lactation yield, lactation length, daily milk yield and age at first calving by percent of Friesian blood,

ii) the average of lactation yield, lactation length and daily milk yield by age at first calving for the 50% Friesian blood,

m) average of lactation yield, lactation length and age at first calving by year and month of calving for the 50% Friesian blood, ,

iv) phenotypic correlations among lactation yield, lactation length, daily milk yield and age at first calving for the 50%, 62.5% and 75% Ftiesian blood.

RESULTS AND DISCUSSION

Lactation yield: The results in Table 1 indicate that the regression model used ex- plained a significant ($P < 0.05$) portion of variation in lactation yield. Looking more closely at individual factors of the model, the results in table 2 show that age at first calving was a significant ($P < 0.05$) source of variation for lactation yield. Table 2 also shows that the 62.5% Frie- sian blood was highly significantly ($P < 0.01$) different from the other blood groups. Lactation yield however was not affected by either year or Season of calving indicating no yearly or seasonal trend. Saeed et. al. (l987), working on Kenana type reported that the effect of month of calving on lactation yield was non-significant ant that of year of calving was highly significant ($P < 0.001$). In their work however, they used a large data set consisting of 364 cows of which had up to seven lactations compared to 133 cows having only the first lactation in the study reported herein. In addition, their year groupings were based on a three-years in- terval which would better detect time trend than our one year groupings.

Table 1: Mean squares for the effect of age, percent of Friesian blood, season and year of calving on some production traits.

Source of variation	df [1]	Lactation Yield	Lactation length	Daily yield	Age at first calving
Regression	13 (2)	9366027.16 *	22516.90 *	33.93	471.61
Error	119 (130)	5273862.45	11673.03	19.59	202.80

1 The value in brackets is the degree of freedom for the effect of percent of Friesian blood on age at first calving

* Significant at $P < 0.05$.

Table 3 shows the average of lactation yield by percent of Friesian. These averages were 4306, 5733 and 4136 lbs for the 50%, 62.5% and 75% Friesian cross-breds respectively. These figures suggest that the 62.5% cross-breds rank first then the 50% and finally the 75% cross- breds. Although these results are in agreement with the general consensus that the intemtediate grades are more productive under tropical condi-

Table 2: Regression coefficients and t - statistics for the effect of age, percent of Friesian blood, and season and year of calving on lactation yield and lactation length. [1]

Variable	Lactation yield coefficient	(df = 119)		Lactation length coefficient	(df = 119)	
Age covariate (month)	54.99	2.19	*	1.67	1.41	
62.5% Friesian blood	2044.51	2.85	**	84.03	2.49	**
75% Friesian blood	- 828.17	- 1.02		- 51.72	- 1.35	
Summer season	679.62	1.32		21.42	0.89	
Autumn season	196.45	0.37		23.02	0.92	
year 1980	120.82	0.18		65.98	2.03	*
year 1981	- 177.75	- 0.21		39.03	0.97	
year 1982	- 1460.80	- 1.86		- 9.42	- 0.26	
year 1983	- 398.20	- 0.46		22.66	0.56	
year 1984	- 1349.06	- 1.38		- 45.38	- 0.99	
year 1985	- 1785.76	- 1.84		- 8.90	- 0.20	
year 1986	485.73	0.43		- 109.55	2.06	*
year 1987	- 3014.19	- 1.63		- 143.39	- 1.65	
constant	2406.04	-		215.07	-	

1 Cows having 50% Friesian blood and calving during the winter of 1979 were taken as the base population with zero coefficients.

* significant at $p < 0.05$.

** significant at $P < 0.01$.

tions, nonetheless we have to guard against making such conclusions as the 62.5% cross-breds used in the study were from a totally different herd (University of Khartoum Farm) This is not to mention the fact that some of these cows might have Butana dams compared to the 50% and 75% cross-breds which originated mainly from Kenana dams at the Ni- sheishiba Dairy Farm. Comparing the latter two grades to each other, it becomes evident that the 50% cross-breds are more productive. In com- paring all the three grades it is very important to mention the fact that the results of the 62.5% and 75% cross-breds were based on small number of records making a valid general conclusion very difficult. Part of the reason for this small number of records is due to the fact that no planned matings were made to increase the number of these grades at the farms under study. Until enough data are available from well designed experi- ments, it is very wise to support the majority of the previous studies (Osman and Russel, 1974) and call for the suitablity of the 50% cross- breds for our tropical conditions. The need for a long tenn crossbreeding experiment investigating the performance of the different European dairy breeds when crossed with Kenana, Butana and Baggara type is of utmost importance.

Table 3: Average lactation yield, lactation length, daily milk yield and age at first calving of 50%, 62.5% and 75% Friesian cross-bred cows.

Percent of Friesian blood	Number of cows	Lactation yield (lbs)	Lactation length (days)	Daily milk yield (lbs)	Age at first calving (month)
50%	109	4306	306	13.23	42
62.5%	14	5733	369	15.53	36
75%	10	4136	298	13.03	50

Table 4 shows the average of the production traits by age at first calving for the 50% cross-breds. The results indicate that 4 to 5-years old cows have the largest average lactation yield (5087 lbs). However, 4 to 5 years is too long a period for an increase of 781 lbs of milk above the mean associated with a reduction of at least one year in the productive life of the cow. Age at first calving of two to three years seems to be a rea- sonable target provided that cows are in good condition. Table 5 and 6 respectively shows the average of lactation yield by month (season) a.nd year of calving for the 50% cross-breds. Both of these two factors were shown to have no significant effect on lactation yield.

Table 4: Average lactation yield, lactation length and daily milk yield by age at first calving for 50% Friesian cross-bred cows.

Age (month)	Number of cows	Lactation yield (lbs)	Lactation length (days)	Daily milk yield (lbs)
- 23	4	3876	282	12.97
24 - 35	42	4184	299	12.56
36 - 47	19	3244	303	10.00
48 - 59	29	5087	318	14.20
60 - 71	15	3836	288	12.99

Lactation length:

The results in Table 1 indicate that the model used had significant ($P < 0.05$) effect on lactation length. Table 2 shows that the percent of Friesian blood was important source of variation and that the 62.5% Frie- sian blood being highly significantly ($P < 0.01$) different from the others. The years of calving were also important source of variation for lactation length. The years 1980 and 1986 were significantly ($P < 0.05$) different from the other years. No significant season effect was detected. The re- sults in Table 3 show that cows with 62.5% Fiiesian blood have the larg- est lactation length (369 days) followed by the 50% cross-breds (306 days) and finally the 75% cross-breds (298

days). These results again suggest that cows with 62.5% Friesian blood stay in milk for longer peri- od of time than the other Friesian cross—breds. Table 4 indicates as in the case pf lactation yield that the 50% cross-breds calving at 4 to 5 years of age stay in milk for a longer period of time than the other age groups.

Table 5: Average lactation yield, lactation length, daily milk yield and age at first calving by month of calving for the 50% Friesian cross-bred cows.

Month	Number of cows	Lactation yield (lbs)	Lactation length (days)	Daily yield (lbs)	Age at first calving
January	4	5722	379	15.44	42
February	6	2864	224	10.62	51
March	10	5834	358	16.14	53
April	13	4636	323	13.73	46
May	4	2081	232	08.72	45
June	10	4458	286	14.17	41
July	10	4694	303	14.74	29
August	10	3818	296	13.80	42
September	8	4896	353	14.09	33
October	8	3538	338	11.71	47
November	9	3866	332	12.28	41
December	17	4143	306	12.47	41

the years 1980 and 1986 had significantly ($p < 0.05$) the highest average of 373 and 359 days respectively (Table 6). The years 1979 and 1984, on the other hand, had the lowest average of 277 and 282 days respec-

tivcly. The general picture is that there is no clear yearly trend in lactation length. Saeed et. al. (1987) found no significant effect of month and year of calving on lactation length.

Table 6: Average lactation yield, lactation length, daily milk yield and age at first calving by year of calving for 50% Friesian cross-bred cows.

Year	Number of cows	Lactation yield (lbs)	Lactation length (days)	Daily milk yield (lbs)	Age at first calving
1978	1	6306	294	21.44	21
1979	26	4193	277	13.96	29
1980	11	3920	373	11.13	29
1981	9	3655	333	09.82	31
1982	13	3106	290	10.27	38
1983	16	5174	336	15.20	52
1984	11	4571	282	16.17	59
1985	18	4159	315	12.20	60
1986	4	4719	359	12.92	45

Daily milk yield: The factors used in the model were not significant sources of variation for daily milk yield (Table 1). The averages of daily milk yield by percent of Friesian blood, age at first calving, month (season) and year of calving are shown in Table 3 through 6. These tables will not be discussed any further due to the insignificance of the factors in the model. Saeed et. al. (1987) also reported insignificant effect of month of calving but highly significant ($P < 0.001$) effect of year of calving on daily milk yield. Age_at first calving: The model used to analyzed this trait contained only the effect of per- cent of Friesian blood. The results in Table 1 indicate that this effect was not a significant source of variation for age at first calving. However, the result was close to significance ($P < 0.07$). Table 3 shows that 62.5% Friesian cross-breds calve the earliest (36 months) followed by the 50% Friesian cross-breds (42 months) and lastly the 75% cross-breds (50 months). The effect of season and year of calving on age at first calving were not formaly investigated. The average of age at first calving by month and year of calving are respectivey shown in Table 5 and 6 for the 50% Friesian cross-breds. A general observation to be made is that cows calving in July through August have the smallest average age (Table 5). Also cows calving in earlier years in 1978 through 1982 calve at an earli- er age than those calving during the recent years of 1983 through 1986 (Table 6). These findings would suggest that no intentional effort was made to reduce age at first calving at Nisheishiba dairy farm. Correlations among production traits: Correlation coefficients among the different production traits are pre- sented in Table 7. These results show that lactation yield was highly posi- tively conelated with lactation length. The values of these correlation ctr efficients were 0.78, 0.60 and 0.94 for the 50%, 62.5% and 75% cross- bneds respectively. As expected the daily milk yield was also highly posi- tively correlated with lactation length. The values of these correlation co- efficients were 0.77, 0.81 and 0.84 for the 50%, 62.5% and 75% Frie- sian cross-breds respectively. The correlation between lactation yield and age at first calving was not significant for the 62.5% and positive for the 50% and 75% cross-breds. However, these positive correlations were not high enough to encourage delayed breeding to later ages. It is there- fore suggested that cows should be

bred to calve at two to three years of age. The correlation between lactation length and daily milk yield was not significant for the 62.5% and positive for the 50% (0.37) and 75% (0.62) cross-breds. This positive sign indicates that the effect of lactation yield on daily milk yield is more important than that of lactation length. The correlation between lactation length and age at first calving was not sig- nificant for all the three cross-bred types. The correlations between daily milk yield and age at first calving were 0.15, - 0.48 and 0.82 for the 50%, 62.5% and 75% cross-breds respec- tively. The negative sign for the 62.5% cross-breds indicates that younger cows tend to have more daily milk yield at calving than older cows. No comparable results are found in the literature. In summary, the most important findings of this study are that cows having 62.5% Friesian blood have significantly more milk yield and stay in milk for longer periods of time than those having the 50% or 75% Friesian blood. No significant differences were found among the three Friesian blood groups with respect to daily milk yield and age at first calving. Considering the health and managernental problems associated with increased Frlesian blood especially under the semi-intensive system coupled with availability of inadaquate records, it is suggested that the 50% Friesian cross-breds would be quite suitable for economic produc- tion under the Sudan tropical climate. More data would be needed on these different grades using different European dairy breed in order to in- vestigate this problem sufficiently. Lactation yield and lactation length were highly positively correlated. The values of these correlation were 0.78, 0.60 and 0.94»for the 50%, 62.5% and 75% Friesian cross-breds respectively. Also lactation yield was highly correlated with ‘daily milk yield with values of 0.77, 0.81 and 0.84 for the 50%, 62.5% and 75% Friesian cross-breds respectively. Lactation yield however, was positive- ly but lowly correlated with age at first calving. This low correlation sug-

Table 7: Correlations[1] among lactation yield, lactation length, daily milk yield and age at first calving for the 50%, 62.5% and 75% Friesian cross-bred cows.[2]

Trait	Lactation yield	Lactation length	Daily milk yield	Age at first calving
Lactation yield	1.00	0.78 *	0.77 *	0.15 *
	1.00	0.60 *	0.81 *	- 0.38 *
	1.00	0.94 *	0.84 *	0.59 *
Lactation length		1.00	0.37 *	0.08
		1.00	0.09 *	0.15
		1.00	0.62 *	0.35
Daily milk yield			1.00	0.15 *
			1.00	- 0.48 *
			1.00	0.82 *
Age at first calving				1.00
				1.00
				1.00

1 The three values given are for the 50%, 62.5% and 75% Friesian blood respectively.
2 The number of cows for the 50%, 62.5% and 75% Friesian cross-bred are 109, 14 and 10 respectively.
* Significant at $P < 0.05$.

gests that cows should be bred to calve as early as possible (preferably two to three years of age). In general the correlations with lactation length were low and in some cases were not significant. The correlation between daily milk yield and age at first calving was positive for the 50% (0.15) and 75% (0.82) but negative for the 62.5% (- 0.48) Friesian cross-breds.

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