GENETIC AND ENVIRONMENTAL FACTORS AFFECTING CALVING INTERVAL IN A COMMERCIAL BEEF HERD IN A SEMI-HUMID TROPICAL ENVIRONMENT

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The effect of season, year, age of da. ant sex of calf on the calving intervals of 459 Zebu cows in a commercial herd in Yucatan State were studied using multiple regression. Mean calving interval (± SE) was 382 ± 3.7 days. There were significant effects (P < 0.0l) of season, year and age of dam. The best season for calving was the period fro. June to September which corresponds to the rainy season. Dams of two and three years of age had the longest calving intervals (427 ± 4.8 days). The calving interval improved to 371 ± 4.9 days in six year old cows and thereafter was more variable. The estimate of the repeatability index was 0.222, which indicated that genetic variation d for calving interval was small compared to other sources of variations.

Key words: Genetics, environmental effects. calving interval, commercial beef cattle.

The time interval between one parturition and the next is called the calving interval. Linares and Plasse (1966) consider that calving interval is the most important character in the productivity of beef cattle and is the best index for evaluating the reproductive efficiency of a herd under field conditions. Reproductive efficiency is fundamentally important in terms of genetic progress and in general for economy and production. Nevertheless there are genetic and environmental factors, such as nutritional level, climatic conditions, diseases, breeding season and breed differences which affect reproductive efficiency, measured as calf crop (Warnick 1967).

In Florida, Plasse et al (1968) obtained mean calving intervals of 374.7 ± 54.2 and 409.9 ± 120.7 days for Brahman cattle. Lemka et al (1973) reported mean calving intervals of 479.0 ± 99 and 418 ± 78 days for Hariana and Deshi cattle in India.

The objectives of the present study were:

1. To determine the length of the calving interval and the factors which affect its variation.
2. The calculation of the repeatability index - for calving interval in a herd of commercial Zebu.

Materials and Methods

The information used in the present study was taken from the reproductive records of a herd of commercial Zebu used for breeding and fattening. The ranch is situated in the municipality of Tizimin, Yucatan State, Mexico.

Cattle management: The cattle grazed during the afternoon and night on Guinea grass (Panicum Maximum) which provided the main part of the diet. Bulls remained with the cows throughout the year at a bull to cow ratio of 1:25. At 6 am the cattle were taken from the pasture and brought to the corrals in which water and a mineral mixture were available. This mixture was available ad libitum throughout the year. At 3 pm the cattle were returned to the pastures.

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Pregnant cows were separated one month before calving into a Guinea grass pasture. After parturition they were transferred to another paddock where cow and calf remained for one month before rejoining the rest of the herd. The calf remained with the dam until nine months of age when it was weaned.

Analyses: The independent variables used in the analysis were sex of calf, age of dam at parturition, year and season of parturition with calving interval being the dependent variable. Records of 1,250 calving intervals for 459 cows in the years 1971 to 1975 were used. The year was divided into three calving seasons (Table 1) with the first being the dry season (scarcity of pasture, dry and hot), the second the rains (abundant pasture, humid and hot) and the third "intermediate" (decreasing availability of pasture, rainfall and temperatures tending to diminish).

Table 1:
Mean monthly distribution of rainfall and temperature in the city of Tizimin, Yucatan (Garcia 1976) and the classification of seasons

		Rainfall (mm)	Temperature (° C)
	February	30. 7	23.1
	March	44.9	25.5
Season 1	April	27.7	26.9
	May	125.4	28.1
	June	188.8	28.0
	July	139. 7	27.7
Season 2	August	147.0	27.9
	September	171.6	27.6
	October	121.2	25.7
	November.	59.1	24.0
Season 3	December	20.3	22.6
	January	29.2	22.3

The ages at calving of the dams were classified from 2, 3.....12 years and the sex of the calf as male or female.

For the analysis, the independent variables, age, year and season of calving were related to the subsequent calving intervals. The sex of the calf was related to the interval during which it was conceived.

The data were analysed using a multiple regression (Barr and Goodnight 1972).

$$Y_{ijklm} = \mu + A_i + C_j + M^k + S^l + E_{ijklm}$$

where: Y_{ijklm} = calving interval for the m^{th} individual in the $ijkl^{th}$ subclass

μ = population mean

A_i = effect of the i^{th} year. i = 1,2.....5

C_j = effect of the j^{th} season in which the cow calved. j =1,2,& 3.

M_k = effect of the k^{th} age of the cow at time of calving k = 2,3..12

S_i = effect of the ith sex of calf. i = 1 or 2

E_{ijklm} =random error $N(0, \theta^2)$

In order to estimate the repeatability index 1122 calving intervals from 331 cows were used. Only cows having two or more observations were included.

The genetic parameter (r) was calculated as the interclass correlation given by the following formula(Pirchner 1964):

$$r = \frac{V(P)}{V(P) + V(T)}$$

where: r = repeatability index

V(P) = variance due to permanent differences in performance between individuals.

V(T) = variance due to temporary differences in performance between individuals in various periods.

The components of variance were estimated using the methods proposed by Snedecor (1966) for samples of unequal size.

Results and Discussion

The analysis of variance of the principal factors affecting calving interval are presented in Table 3. The overall mean and the least squares constants are presented in Table 2. The overall mean for calving interval (+ SD) was 382 + 64 days, which indicates good reproductive efficiency (De Alba 1970). This value is better than that calculated by Plasse et al (1968) and worse than that obtained by Lemka et al (1973). Factors which possibly contributed to this good result were that the herd was free of brucellosis, which reduced the possibility of abortions, and the elimination of cows which were infertile for various reasons.

Table 2:
Least squares constant (days) for the independent variables considered in the model

	Number of observations	Calving interval
Overall mean ± SE (days)	1250	382.03 ± 3.7
Standard deviation (days)		± 64.1
Year		
1971	252	+12.80 ± 3.8
1972	281	+2.51 ± 3:6
1973	249	-8.97 ± 3.8
1974	253	+10.29 ± 3.7
1975	215	-16.63 ± 3.8
Season		
1 (February, March, April, Hay)	504	-1.57 ± 2.6
2 (June, July, August, September)	338	-7.20 ± 2.8
3 (October, November, December, January)	408	+8.77 ± 2.7
Age of Dam (years)		
2	15	+51.61 ± 15.7
3	104	+38.27 ± 5.9
4	96	+3.75 +7.0
5	130	+0.45 ± 6.4
6	169	-0.75 ± 5.9
7	186	-5.15 ± 5.7
8	178	-13.17 ± 5.7
9	182	-8.71 ± 5.7
10	109	-2.31 ±6.7
11	16	-30.50 ± 15.0
12	5	-23.49 ± 15.9
Sex		
Female	644	-3.35 ± 1.8
Male	606	+3.35 ± 1.9

Table 3:
Analysis of variance for the effect of year, season, age of dam and sex of calf, on calving interval

Source of variation	d.f.	Mean squares	Coefficient of determination (R^2)
Year	4	27555.06**	0.095
Season	2	27770.46**	
Age of dam	10	35239.32**	
Sex of calf	1	13921.09	
Error	1232	4114. 26	
Total	1249		

** P<0.01

Age of dam: There was a significant effect (P< 0.01) of age of dam on calving interval (Table 3) in agreement with that found by Plasse et al (1968). As can be seen (Table 2) the calving interval decreased until the cows reached six to seven years of age. Cows of two and three years of age had mean calving intervals of 433 and 420 days,respectively. The suggestion that the calving interval was longer for young cows was in agreement with Buck et al (1976). This result is probably due to the delay in onset of oestrus after calving in lactating heifers (Warnick 1963) and may be caused by the ',stress" of lactation, which is greater in heifers than in older cows. On the other hand the lower weight at calving of the heifers combined with the previous effect, influenced the lengthening of the service period (Buck et al 1976) and the subsequent reproductive rate (Reynolds 1967). Part of this improvement could be due to the culling of the cows as previously mentioned. After seven to eight years of age there are no clear differences, although the suggestion of a lengthening of the calving interval after nine years of age coincides with teeth problems, increased incidence of joint injuries and general aging (Smith 1962). A smaller number of cows of eleven to twelve years of age confirm this and their good performance is probably the reason for their remaining in the herd.

Effect of season: There was a significant effect (P< 0.01) of season on calving interval (Table 3) as was found by Lemka et al(l973) in Deshi cattle. Cows had the best calving interval when they calved during the period from June to September (375 days), the period which coincides with the heavier rainfall and better availability of forage in the area (Table 1).

Effect of sex: The mean calving interval of 385 and 379 days for male and female calves respectively were not significantly different (Table 3). Apparently the effect of sex is associated with length of gestation period, male calves tending to provoke longer gestation periods than females (De Alba 1970). Nevertheless the differences were small and not significant in this study.

Repeatability index: There were no significant differences in calving intervals between cows (Table 4). The repeatability index, 0.022, is similar to those obtained by Plasse et al (1968) of 0.03 and 0.08 in Brahman cattle and slightly less than those calculated by Lemka et al (1973) 0.12 and 0.10 in Hariana and Deshi cattle, respectively. This result shows that the genetic variation in calving interval is very small relative to the variation caused by other factors and,in spite of the justification to eliminate animals with poor reproductive efficiency, the genetic improvement in calving interval will be limited.

Table 4:
Analysis of variance and repeatability index for calving interval

Source of variation	d.f	M.S.	Components of variance	Index of repeatability (r)
Between dams	330	4445.716	95.77	
Within dams	791	4121.242	4121.242	0.022
Total	1121			

* Includes all dams with two or more observations

Acknowledgements

The authors wish to express their gratitude to the Director of Agriculture and Cattle Production of the Yucatan State Government for having made possible the completion of this study. To Sr Armando Barrera for having supplied the data from his ranch. To the personnel of the Universidad Autonoma de Chapingo especially to Sr M Reyes. To the Drs L Alpuche, F Ayala and E Monforte for their help in the compilation of the information. To Dr V Fernandez for the revision of the manuscript and to U F Hinojosa and L E Farfan for the typing.

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Received 7 November 1978