

# INFLUENCE OF AGE AT FIRST CALVING ON THE MILK PRODUCTION OF NATIVE AND CROSSBRED DAIRY COWS

U.N. Khan<sup>1</sup>, L.L. Benyshek<sup>2</sup>, M.D. Ahmad<sup>3</sup>,  
M.Z. Chaudhary<sup>4</sup> and S.M. Athar<sup>5</sup>

Animal Sciences Institute, National Agricultural  
Research Center, Park Road, Islamabad, Pakistan.

## Summary

The influence of age at first calving on the milk production of crossbred dairy cows produced under major dairy cattle crossbreeding projects in Pakistan was studied from the year 1974 to 1980. These animals were bred and raised at the Livestock Production Research Institute, Bahadarnagar (LPRI), Livestock Experiment Station, Karachi (LES) and the University of Agriculture, Faisalabad (UAF). Local Sahiwal (SWI) cattle were crossed with the European breeds, Holstein Friesian (HF) and Jersey (J) at LPRI and UAF. At LES, native Red Sindhi (RS) were crossed with the HF and J breeds. At LES and UAF, the crossbred progeny, thus, produced comprised of halfbreds only while at LPRI 3/4 HF, 3/4 I, 1/4 HF and 1/4 J groups were also available for this study. The average age at first calving was considerably higher among the native breeds. At LES, the RS calved for the first time at an age of approximately 56 months. Corresponding values for SWLs at LPRI and UAF were 44 and 64 months, respectively. The 1/2 HF and 1/2 J crossbreds calved first at the age of approximately 25, 26, 34, 36, 37 and 38 months at LPRI, LES and UAF respectively. For 3/4 HF, 3/4 J, 1/4 HF and 1/4 J groups of LPRI the average age at first calving was 29, 26, 34 and 33 months. Considerable differences in age at first calving between the crossbreds and native breeds were observed. Due to early maturity, the former attained the peak level of milk production in third lactation whereas the latter groups, because of late maturity, reached this level in their fourth lactation. This study suggested that early maturity in Zebu cattle (*Bos indicus*) could be induced through crossbreeding with European cattle (*Bos taurus*)

(Key Words: Age, Calving, Milk Production, Crossbred, Dairy)

## Introduction

Apart from various other factors, delayed first calving in dairy cattle makes the milk production uneconomical. Early maturity is considered as a character of great economic importance as from birth to the date of first calving, the animal produces nothing except dung and urine, the value of which is negligible as compared to the cost of maintenance. The age at first calving in the indigenous cattle is higher by about 12 months versus

the improved European breeds. The latter are reported to fresh at the age of about 24-28 months.

Previous studies on Sahiwal, Red Sindhi, Tharparkar and Hariana cattle revealed that age at first calving and first lactation yield were independent of each other and reduction in age at first calving (within physiological limits) would have no deleterious effect on heifer yield (Sundaresan et al., 1954; Mahadevan, 1955; Singh and Choudhary, 1961; Singh and Acharya, 1969). On the other hand, Venkayya and Anantkrishnan (1956) and Kushwaha and Misra (1969) observed that the two traits were significantly correlated and first lactation yield tended to increase with reduced age at first calving among the Red Sindhi and Sahiwal cows.

This work was carried out to study the influence of age at first calving on the milk production of major indigenous dairy cattle and their crossbreds.

## Materials and Methods

<sup>1</sup>Address reprint requests to Dr. U. N. Khan, Animal Sciences Institute, National Agricultural Research Center, Park Road, Islamabad, Pakistan.

<sup>2</sup>Animal Sciences Department, The University of Georgia, Athens, GA 30602, USA

<sup>3</sup>Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan.

<sup>4</sup>Livestock Production Research Institute, Bahadarnagar District, Okara, Pakistan.

<sup>5</sup>Poultry Research Institute, Karachi-14, Pakistan

Received March 11, 1989

Accepted September 1, 1989

The data were obtained from the following projects:

1. Breeding adapted strains of dairy cattle through crossing Sahiwal, Jersey and Holstein Friesian. This project was implemented at the University of Agriculture, Faisalabad (UAF) in July, 1973.
2. Study on the production performance and adaptability of crossbred cows under the subtropical environment of the Punjab. This project was implemented at the Livestock Production Research Institute (LPRI), Bahadarnagar, District Okara in November, 1974.
3. Studies on evolving well-adapted synthetic strains of dairy cattle with superior production by crossing indigenous milk breeds with suitable improved exotic breeds. This project was implemented in Sind province at Livestock Experiment Station (LES), Karachi in July, 1975.

Local Sahiwal (SWL) cattle were crossed with frozen semen of two European breeds, Holstein Friesian (HF) and Jersey (J) at the LPRI and UAF. At LES, native Red Sindhi (RS) were crossed with semen of HF and J breeds. At the LES and UAF, the crossbred progeny, thus produced comprised of halfbreds only while at LPRI, 3/4 HF, 3/4 J, 1/4 HF and 1/4 J groups were also available for this study. The crossbreds produced at the 3 stations were compared with respective native breed (SWL or RS) to determine the influence of age at first calving on milk production. There were 40 RS and 110 SWL native cattle available as control against 274 crossbreds in ten different genetic groups during the seven years (1973-80) of the study period.

Following linear model or its appropriate derivation were used for the statistical analyses:

$$Y_{ijkl} = \mu + SB_i + DB_j + Y_k + (SD)_{ij} + (SY)_{ik} + b_1(DIM)_{ijkl} + b_2(DIM)_{ijkl}^2 + e_{ijkl}$$

Where,

- Y = Character measured on the ijklth individual;  
 $\mu$  = The population mean common to all records;  
 $SB_i$  = The effect of the ith sire breed;  $i=1, \dots, 3$ ;  
 $DB_j$  = The effect of the jth dam breed;  $j=1, \dots, 4$ ;

$Y_k$  = The effect of the kth year group of calving;  $K = 1, \dots, 6$ ;

$(SD)_{ij}$  = The interaction between ith sire breed and jth dam breed;

$(SY)_{ik}$  = The interaction between ith sire breed and kth year of calving;

$(DIM)$  = Days in milk (lactation length);

$(DIM)^2$  = Quadratic effect of lactation length;

$b_1$  and  $b_2$  = Partial regression coefficients of the character;

$e_{ijkl}$  = Random error associated with the  $Y_{ijkl}$ th observation.

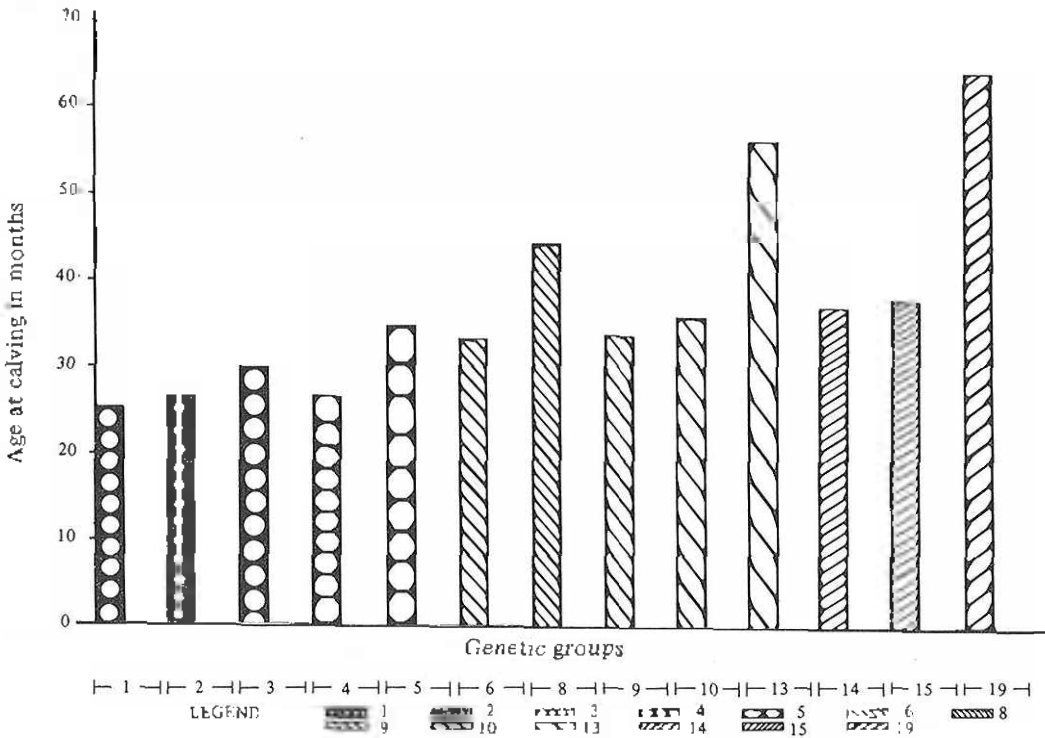
The phenotypic correlations ( $r_p$ ), used as a measure of association between the traits were computed as described by Harvey (1977).

## Results and Discussion

The average age at first calving for various genetic groups is presented in figure 1. It is evident that  $F_1$  crosses with Holstein Friesian and either of two native breeds (Sahiwal or Red Sindhi) initiated their lactations at a relatively younger age. It is also clear from figure 1 that an increase with Zebu or European inheritance resulted in an increase in the age at first calving. The average age at first calving in Sahiwal ( $44.33 \pm 6.22$  mo.) was less than that reported by Ahmad and Ahmad (1974) apparently due to selection practiced at LPRI over the years. However the average age at first calving in Red Sindhi ( $56.07 \pm 8.06$  mo.) found in this study was higher than that reported in literature (Amble et al., 1967; Wahid, 1975; Khan, 1977; Manickam et al., 1978), probably because of smaller number of animals maintained at LES.

It is believed that there is a high correlation between age at calving and respective lactation number. This phenomenon is biologically acceptable. However, a large variability in age at first calving needs further attention. The phenotypic correlations between age at first calving and other traits are presented in table 1. From these results no specific trend of association is evident and more data would be needed for future studies. Likewise the relationship between age at first calving and milk yield in first lactation was found statistically nonsignificant, with a few exceptions. A significant or nonsignificant correlation between these two traits can readily be located in the

AGE AT FIRST CALVING AND MILK PRODUCTION

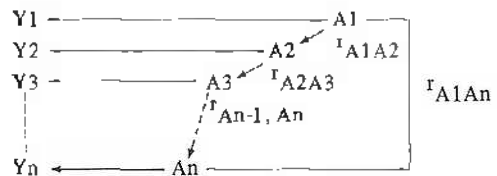


Group 1, 9 and 14 represent 1/2 HF at LPRI, LES and UAF respectively  
 Group 2, 10 and 15 represent 1/2 J at LPRI, LES and UAF  
 Group 3 and 4 represent 3/4 HF and 3/4 J at LPRI  
 Group 5 and 6 represent 1/4 HF and 1/4 J at LPRI  
 Group 8 and 19 represent SWL at LPRI and UAF  
 Group 13 represents RS at LES.

Figure 1. Average age at first calving.

literature, for instance Venkayya and Anantakrishnan (1957) and Puri and Sharma (1965) found a significant correlation while Singh and Sinha (1960), Singh and Choudhury (1951), Mahadevan and Hutchinson (1964), Sidhu (1964) and Patil et al.(1980) are among those who reported a nonsignificant correlation between age at first calving and first lactation milk production. However, it is worth mentioning that correlations and regressions for age at calving and milk production will only explain the linear part of the relationship.

Let  $Y_1, Y_2, \dots, Y_n$  be the milk production in subsequent lactations and  $A_1, A_2, \dots, A_n$  age at calving for respective lactation, then the relationship between milk production, age at first calving and age at subsequent calving can be expressed as follows:



The influence of age at first calving on milk production in  $n$ th lactation is through the correlation between ages at first and  $n$ th lactation, which ranged from 0.59 to 0.87 in this study. Such a high relationship has a biological bearing. It is well known to animal breeders that animals calving at a younger age are most likely to have a shorter calving interval in their subsequent parity. Among the various causes of late age at first calving and subsequent calvings two factors seem most important, that is a defective overall management

TABLE 1. PHENOTYPIC CORRELATIONS BETWEEN AGE AT FIRST CALVING AND TRAITS ASSOCIATED WITH FIRST PARITY

Location/Genetic group	Days in milk	Milk yield	Days dry	Days open	Calving interval	Gestation length
<b>A. LPRI:</b>						
1/2 HF-1/2 SWL	.04	-.17	-.05	-.01	-.01	.48**
1/2 J-1/2 SWL	.07	-.29	-.11	-.02	-.05	-.43**
3/4 HF-1/4 SWL	-.34*	.10	.02	.08	-.09	.08
3/4 J-1/4 SWL	.28	.49	.69	.82*	.80*	-.30
1/4 HF-3/4 SWL	.26	.56*	.42	.61*	.41	-.29
1/4 J-3/4 SWL	-.16	.09	-.06	-.86	-.86	.21
Sahiwal (SWL)	-.03	-.03	-.04	-.04	.01	.01
<b>B. LES:</b>						
1/2 HF-1/2 RS	-.29	-.11	-.39	-.54	-.51	.04
1/2 J-1/2 RS	-.31	-.08	.61	.92**	.95**	.62*
Red Sindhi (RS)	.19	.32	.54*	.62**	.59**	.10
<b>C. UAF:</b>						
1/2 HF-1/2 SWL	.03	-.29	.05	.06	.28	-.29
1/2 J-1/2 SWL	.57	.74*	-.36	.68	.12	.14
Sahiwal (SWL)	.19	.19	.40	.88	.66	.18

\* p &lt; .05

\*\* p &lt; .01

TABLE 2. PARITY, LACTATION LENGTH AND MILK PRODUCTION AT LPRI

Genetic group	Lactation number	Lactation length (days)	Actual milk (liters) Mean $\pm$ SD	Percentage of first lactation
1/2 HF-1/2 SWL	1	317	2725.29 $\pm$ 972.15	100.00
	2	335	2534.34 $\pm$ 840.71	92.99
	3	257	3177.38 $\pm$ 954.37	116.59
	4	261	3075.52 $\pm$ 786.71	112.85
	5	253	2791.15 $\pm$ 767.18	102.42
1/2 J-1/2 SWL	1	301	2363.25 $\pm$ 622.43	100.00
	2	330	2054.92 $\pm$ 481.95	87.95
	3	286	2625.26 $\pm$ 1137.24	111.09
	4	242	2039.95 $\pm$ 969.44	86.32
	5	232	1742.43 $\pm$ 546.05	73.73
Sahiwal (SWL)	1	266	1426.87 $\pm$ 514.39	100.00
	2	249	1385.90 $\pm$ 632.38	97.12
	3	251	1564.81 $\pm$ 571.30	109.67
	4	243	1595.90 $\pm$ 566.45	111.85
	5	222	1405.67 $\pm$ 656.33	98.51

HF : Holstein Friesian  
J : Jersey

AGE AT FIRST CALVING AND MILK PRODUCTION

or the inability of a particular animal to grow and develop fast enough to attain early sexual maturity.

The milk production of F<sub>1</sub>'s and native cattle in different lactations as a percentage of production in the first lactation is presented in table 2 through table 4. It was interesting to note that the milk yields in the second lactation were invariably lower than that of the other lactations. Appar-

ently, the young heifers being the experimental animals had received an extra attention and care from birth through first lactation. By the time these animals reached in third or fourth parity, they attained full maturity and produced more milk. In fact the peak level of milk production was attained in the third lactation in F<sub>1</sub> cross-breds while native breeds waited until fourth lactation to reach the peak level of production. Lobo

TABLE 3. PARITY, LACTATION LENGTH AND MILK PRODUCTION AT LES

Genetic group	Lactation number	Lactation length (days)	Actual milk (liters) Mean $\pm$ SD	Percentage of first lactation
1/2 HF-1/2 RS	1	272	2176.35 $\pm$ 729.08	100.00
	2	277	1696.00 $\pm$ 865.44	78.25
	3	227	2318.30 $\pm$ 936.13	106.96
1/2 J-1/2 RS	1	218	2331.40 $\pm$ 1129.99	100.00
	2	208	1774.50 $\pm$ 369.80	76.11
	3	257	2328.50 $\pm$ 1530.89	99.88
	4	217	2482.00 $\pm$ 1681.33	106.50
Red Sindhi (RS)	1	227	1317.56 $\pm$ 392.32	100.00
	2	205	1135.33 $\pm$ 493.39	86.17
	3	193	1306.28 $\pm$ 538.60	99.14
	4	231	1970.00 $\pm$ 664.88	149.52

HF : Holstein Friesian  
J : Jersey

TABLE 4. PARITY, LACTATION LENGTH AND MILK PRODUCTION AT UAF

Genetic group	Lactation number	Lactation length (days)	Actual milk (liters) Mean $\pm$ SD	Percentage of first lactation
1/2 HF-1/2 SWL	1	446	3950.87 $\pm$ 1269.05	100.00
	2	365	3230.53 $\pm$ 959.19	81.77
	3	404	4425.09 $\pm$ 1718.50	112.00
	4	325	3493.67 $\pm$ 1362.53	88.43
	5	384	4013.00 $\pm$ 531.74	101.57
1/2 J-1/2 SWL	1	357	2594.28 $\pm$ 1598.79	100.00
	2	288	2456.67 $\pm$ 1146.21	94.69
	3	309	3171.80 $\pm$ 1421.43	122.26
	4	315	3062.33 $\pm$ 613.93	118.04

HF : Holstein Friesian  
J : Jersey  
SWL : Sahiwal

et al. (1983) also observed highest milk yield in fourth lactation in Gir cattle of India. This may partly be due to late age at first calving in native breeds. The lactation records available to study the lactation curves beyond the peak levels were insufficient in the present investigation. However, a decline in production at a later stage could be expected based on the previous studies.

A definite relationship between age at first calving and milk yield in subsequent lactations was established in the present study. It was also evident that the crossbreds attained sexual maturity at a considerably younger age as compared to the native breeds. Consequently, the crossbred cows reached the peak level of milk production in third lactation whereas the native cattle reached this level in their fourth lactation. These results suggest superiority of crossbreds in terms of growth and development to attain sexual maturity. These results also suggest that early maturity in Zebu cattle could be induced through crossbreeding with European breeds.

#### Acknowledgements

Thanks are due to Livestock Production Research Institute, Bahadarnagar; University of Agriculture, Faisalabad and Livestock Experiment Station, Karachi for providing data from their dairy cattle crossbreeding projects. Thanks are also due to Pakistan Agricultural Research Council, Islamabad and United States Agency for International Development for providing financial assistance. Our job would not have been completed without the cooperation of the above mentioned institutes as well as the University of Georgia

#### Literature Cited

- Ahmad, Z. and M. D. Ahmad. 1974. Effect of age at first calving on length of first lactation dry period and calving interval in Sahiwal cows. *J. Agri. Pakist.* 25(1) 45-48.
- Ambale, V. N., K. S. Krishnan and P. N. Soni. 1967. Analysis of breeding data of some Indian herds of cattle. *Anim. Breed. (abst.)* 37:216
- Harvey, W. R. 1977. *User's Guide for LSML76*. Ohio State Univ. Columbus, Ohio.
- Khan, U. N. 1977. Influence of age at first calving and calving interval on most probable (milk) producing ability of Red Sindhi cattle. Unpublished M.Sc (Hons) Thesis. Univ. Sind, Pakistan.
- Kushwaha, N. S. and R. C. Misra. 1969. Study of some economic characters in dairy cattle as influenced by age at first calving. *Indian J. Dairy Sci.* 22:81-84.
- Lobe, R. B., E. B. De Oliveriria-Filho, F. A. M. Daurte, A. A. M. Goncalves and A. A. Ramos. 1983. Effects of age at first calving, gestation length and dry period on milk yield in Gyr herd. *Anim. Breed. (abst.)* 51(11):807
- Mahadevan, P. 1955. Population and production characteristics of Red Sindhi cattle in Ceylon. *J. Dairy Sci.* 38:1231-1241.
- Mahadevan, P. and H.G. Hutchinson. 1964. The performance of crosses of *Bos taurus* and *Bos indicus* cattle for milk production in the coastal region of Tanganyika. *J. Anim. Prod.* 6:331-336.
- Manickam, R., V. Kathaperumal and P. Sadasivam. 1978. A comparative study of some economic traits in Sindhi and ½ Jersey - ½ Sindhi crossbreds. *Indian Vet. J.* 55(6): 462-465.
- Patil, R. R., G. Singh, M. Parshad, R. K. Sharma and B. S. Dhaka. 1980. Milk yield of crossbred (Friesian X Sahiwal) cows in relation to age at first calving, lactation length, service and dry period. *Indian J. Dairy Sci.* 33(4):519-521.
- Puri, T. R. and K. N. S. Sharma. 1965. Prediction of life time production on the basis of first lactation yield and age at first calving for selection of dairy cattle. *J. Dairy Sci.* 48:462-467.
- Sidhu, N. P. 1964. Effect of season of calving on milk production and age at first calving and its effect on first lactation and subsequent production. *Indian J. Dairy Sci.* 17:83-86.
- Singh, M. and R. M. Acharya. 1969. Inheritance of part lactation in Harjana cattle. *J. Dairy Sci.* 52:775-779.
- Singh, K.P. and S.K. Choudhury. 1961. Influence of age at first calving on the first lactation performance in dairy cattle. *Indian J. Dairy Sci.* 14(3):95-101.
- Singh, O. N. and N. C. Sinha. 1960. Effect of age at first calving on milk production, reproduction and longevity in Tharparkar cattle. *Indian J. Dairy Sci.* 13: 163-169.
- Sundaresan, D., F. E. Eldridge and F. W. A. Atkeson. 1954. Age at first calving used with milk yield during first lactation to predict life time production of Indian cattle. *J. Dairy Sci.* 37:1237-1282.
- Venkayya, D. and C. P. Anantkrishnan. 1956. Influence of age at first calving on milk yield, lactation length and calving interval. *Indian J. Dairy Sci.* 9:164-172.
- Venkayya, D. and C. P. Anantkrishnan. 1957. Influence of age on milk production of dairy cattle. *Indian J. Dairy Sci.* 10:100-105.
- Wahid, A. 1975. Livestock resources of Pakistan. Red Sindhi cattle. Univ. Karachi Monograph No. 6.