Explor. Anim. Med. Res., Vol. 1, Issue - 2, 2012. p- 124-130

OPTIMIZATION OF AGE AT FIRST CALVING IN KARAN FRIES CATTLE

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ABSTRACT : Data on 571 Karan Fries (crossing Tharparkar and Sahiwal cows with American Holstein Friesian sires) at NDRI, Karnal was studied for determination of optimum age at first calving (AFC). Least squares analysis (Harvey, 1975) was used to see the effect of sire, period and season of calving and was corrected for significant effect of non-genetic factors. The genetic and phenotypic parameters was estimated for the sires which had five or more progenies. The relationship between age at first calving with other traits were studied by using regression analysis and class interval method. The least squaqres means of age at first calving (AFC), first lactation 305 days or less milk yield (FL305Y), first lactation total milk yield (FLTMY), milk yield per day of first lactation length (MY/FLL) and milk yield per day of first calving interval (MY/FCI) was estimated as 940.98 ± 44.24 days, 3199+ 44.24 kgs, 3599.06 ± 54.96 kgs, 10.50 ± 0.14 kgs and 7.52 ± 0.26 kgs , respectively. The heritability estimates of these traits were moderate. The AFC had significant and positive phenotypic correlation with FL305Y, FLTMY, MY/FLL and MY/FCI. The genetic correlation of AFC with FLTMY was positive. Relationship between AFC and first lactation production traits could not be explained through regression analysis therefore class interval method was used to find at the relationship. Eight classes of AFC was used to find out the relationship. Optimum AFC was identified based on higher milk production and numbers of animals in various classes as 26-36 months. To determine the optimum range of AFC, much emphasis should be given as maximum profit rather than maximizing milk production.

Key Words : Cattle , Karan-Fries, AFC, Optimization.

INTRODUCTION :

Livestock production has enormous potential to improve the socioeconomic status of rural population in Indian agricultural scenario. Though sufficient improvement in milk production has been achieved during last decade still it is insufficient to meet the requirement. Genetic improvement has been made through cross breeding for high production. But our aim should be not only produce high producer animal but also, it should develop an economic & profitable production system.

Overall economic return from individual animal depends upon various performance and reproduction traits beside milk production. Age at first calving is one of the important factor contributing to economic return and are controlled mostly by managemental practices. A balancing of this trait is required to achieve maximum return.

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The age at first calving changes the heifer from a non-producing expensive item into an income generating cow. Early AFC reduces unproductive period and higher the AFC will be the additional rearing cost of the animal. So, it is essential to assess at what age the animal should be bred for the first time to get on optimum balance between expected increase in production and expected increase in additional rearing and other cost to maximize net return in the first lactation. The literature is scanty on optimization of economic traits with respect to production performance of large dairy breeds. So the study was made with the objective, to determine the optimum age at first calving for maximize milk production in the first lactation in Karan Fries cattle.

MATERIALS AND METHODS :

Source of data : The data on 571 Karan Fries Cattle spread over a period of 18 yrs (1978-1995) maintained at the cattle yard of National Dairy Research Institute, Karnal (Haryana) were complied. The cross breed cattle maintained at this farm were exposed to extreme climatic stress due to wide range of various meteorological factors. Loose housing system was fallowed here. The nutritional requirement was met through both roughages and concentrate. The animals were bred through artificial insemination. All types of veterinary aids, prophylactic and sanitary measures were taken care.

The records of Karan Fries Cattle of known pedigree and with normal lactation were included. The cow calved and dried under normal physiological condition and the period of milk production for at least 150 days and more than 500 kg milk yield by a cow was considered as normal lactation. The collected data were classified into four different periods and each into four different seasons in order to quantify the effect of different non-genetic factors on various economic traits.

Statistical analysis : The means, Standard deviations, standard errors and coefficient of variation of all economic traits were calculated using standard statistical procedures described by Steel and Torrie (1980). In order to study the effect of various non-genetic factors, such as period and season on different economic traits and to overcome the problem of non-orthogonality of data due to unequal and disproportionate sub-class frequencies least squares analysis of fitting constants as suggested by Heavy (1975) was used for analysis of data. In order to estimate various genetic and phenotypic parameters, data on various reproduction and production traits were adjusted for significant effects of different non-genetic factors. Sires which had at least five daughters were considered for estimation of genetic and phenotypic parameters. The heritability estimates were obtained by paternal half sibs correlation method (Becker 1986).

For optimization of level of AFC to maximize milk production 8 classes of AFC was compared. For simplicity and also to get sufficient numbers of observation in each classes, an interval of 60 days were taken which is almost equal to the 0.5 standard deviation of the trait. The classes were >791 days, 791-850 days, 851 - 910 days, 911 - 970 days, 971 - 1030 days, 1031 - 1090 days, 1091 - 1150 and > 1150 days. The variation in first lactation 305 days milk yield, first lactation total milk yield, milk yield per day of first lactation length and milk yield per day of first calving interval due to age at first calving were studied by using polynomial r*eg*ression models (Draper and Smith 1981). All linear, quadratic and cubic r*eg*ression models were used. The coefficient of determination were used for the purpose of selecting the best r*eg*ression models. Average of predicted value of these traits for each class of age at first calving were calculated. The significant differences among means of different classes were studied by using least squares analysis (Heavy 1975). The test of significance in the least squares model were, determined by F-test. Where ever the differences were significant, the difference between each pair of classes were tested by modified

Duncan's Multiple Range Test (Kramer 1957).

RESULTS AND DISCUSSION :

The overall least squares mean for age at first calving (AFC) was found to be 940.982 18.22 days in Karan Fries cattle. This estimate agreed with the study reported by Patil *et al*. (1980), Jadhav an Balaine (1980), Singh *et al*. (1988) and Jodhav and Khan (1996) his various HF cross. Least squares analysis of variance revealed significant (P<0.05) effect of sire, season and period of birth on AFC in Karan Fries Cattle. These study agree with those reported by Su (1988); Singh (1995) in Karan Swiss and Karan Fries cattle for effect of sire on AFC. MY/FLL and MY/FCI were estimated to be 3199.23 ± 44.24 kg , 3599.06 ± 54.96 kg , 344.54 ± 3.38 kg , 10.50 ± 0.14 kg and 7.52 ± 0.26 kg , respectively. The effect of sire was significant (P< 0.05) on FL 305Y and MY/FLL but had non-significant effect on other first lactation production traits. Period of birth significantly affected FLL and MY/FLL. Season of birth of animal had significant effect on FLL but non-significant effect on FL305Y, FLTMY, MY/FLL and MY/FCI. From Table 1 it is also observed that AFC had significant effect on MY/ FLL and MY/FCI but non-significant effect on other first lactation production traits. Garcha *et al*. (1991) in HFXSW crosses and Singh (1995) in KF Cattle

Table 1 : Estimates of genetic and phenotypic parameters in Karan Fries cattle.

Traits	AFC	FB05Y	FLTMY	MY/FLL	MY/FCI
AFC	0.361±0.197	0.211±0.060*	0.261±0.054**	0.249±0.060**	0.246±0.064**
FL305Y	- 0.215±0.479	0.217±0.167	0.807±0.036**	0.883±0.028*	0.886±0.030**
FLTMY	0.215±0.460	0.833±0.174	0.188±0.161	0.629±0.047**	0.748±0.043**
MY/FLL	>1	>1	>1	0.260±0.130	0.895±0.029**
MY/FCI	0.056±0.701	0.526±0.719	0.922±0.142*	-0.206±0.428	0.220±0.140

Diagonal Values : Heritability
Lower diagonal Values : Genetic Correlation
Upper diagonal values : Phenotypic correlation.

* Indicate Significant (P<0.05)
** Indicate Significant (P<0.01)

Significant effect of season of birth was also reported by Parmer *et al* (1986) and Nayak and Reheja (1996) in various exotic crosses. Nagarcenkar and Rao (1982), Singh *et al*. (1988) and Nayak and Raheja (1996) reported significant effect of period of birth in HF crosses. The variance in AFC in different season and period of birth may be due to difference in availability of feeds and fodder, feeding and management practices in different reason and periods.

Least squares of means of FL305Y, FLTMY, FLL, found non-significant effect of AFC on MY/FLL and MY/FCI which is contraindicating with this study.

Estimation of genetic cow phenotypic parameters:

Estimation of genetic cow phenotypic parameters were required to evaluate the variation in performance with respect to genetic and non-genetic factors to investigate whether any variation exists between the characters.

The heritability (h2) of AFC was estimated to be

Table 2 : Regression analysis of various first lactation production traits on age at first calving in Karan Fries cattle.

Traits	Type of equation	Intercept constant b_0 ± S.E.	Regression coefficients b_1 ± S.E.	b_2 ± S.E	b_3 ± S.E	Multiple correlation coefficient(R)	Coefficient of Determination (R^2 %)
FL 305Y	L	2562.8684 ± 30.7984	0.6086876 ± 0.1630970**	-	-	0.1546	2.39
	Q	2331.8774 ± 30.7043	1.5600144 ± 0.4718120**	-0.0007243 ± 0.0003372*	-	0.1838	3.18
	C	2331.6687± 30.7323	1.5770025 ± 0.4643556**	-0.0007783 ± 0.0002904**	0.0000001 ± 0.0000001	0.1838	3.18
FL TMY	L	2592.1208 ± 47.4156	0.8861368 ± 0.2510955*	-	-	0.1464	2.14
	Q	2145.7781 ± 47.1753	2.6778407 ± 0.7249106**	-0.0013642 ± 0.0005181**	-	0.1823	3.32
	C	2145.7288 ± 47.2167	2.6818492 ± 0.7134302**	-0.0013722 ± 0.0004462**	0.0000001 ± 0.0000001	0.1823	3.32
MY/ FLL	L	7.1605 ± 0.1455	0.0025588 ± 0.00007706**	-	-	0.1379	1.90
	Q	5.6285 ± 0.1446	0.0087083 ± 0.0022214**	-0.0000047 ± 0.00000016**	-	0.1838	3.38
	C	5.6282 ± 0.1447	0.0087316 ± 0.0021862**	-0.0000047 ± 0.0000014**	0.0000001 ± 0.0000001	0.1838	3.38
MY/ FCI	L	5.1694 ± 0.1514	0.0022378 ± 0.0008019**	-	-	0.1162	1.35
	Q	3.8801 ± 0.1508	0.0074130 ± 0.0023176**	-0.0000039 ± 0.0000017**	-	0.1524	2.32
	C	3.8798 ± 0.1510	0.0074409 ± 0.0022809**	-0.0000040 ± 0.0000014**	0.0000001 ± 0.0000001	0.1524	2.32

* Indicate significant at (P < 0.05) , ** Indicate significant at (P < 0.01)

0.361 ± 0.97). The moderate h2 of AFC indicates that this trait is greatly influenced by genetic factors and less by non-genetic factors. So, Improvement can be made through by selection. Lower estimates of h2 of AFC was reported by Singh *et al*. (1988) and Khan (1992) in HF cross however higher estimates of h2 were reported by Agasti *et al*. (1988) and Singh (1995) in various crossbred.

The heritability estimates of FL305Y, FLTMY, FLL, MY/FLL and MY/FCI were low to moderate (0.22 ± 0.17, 0.19 ± 0.16, 0.093 ± 0.101, 0.26 ± 0.13 cow 0.22 ± 0.14 respectively) (Table 2). These results indicate that those production traits are more governed by additive genetic factors and there is ample scope of improvement by selection. Moderate to high estimates of h2 (0.20 to 0.50) for various milk productiion traits were reported by Sachdeva and Gurnani (1989), Rao and Nagarcenkar (1992) in Friesian crosses and Singh (1995) in KS and KF crosses. Lower (0.10 to 0.20) estimates of h2 were reported by Kumar (1987), Garcha *et al*. (1991) and Raheja (1994) in different crossbred cattle.

The AFC had significant and positive phenotypic correlation with FL305Y, FLTMY, FLL, MY/FLL and MY/FCI (0.21 ± 0.06, 0.26 ± 0.05, 0.17 ± 0.06, 0.25 ± 0.006 and 0.25 ± 0.06 respectively). This positive and significant correlation of AFC with production traits indicate that higher AFC will improve the performance of the above mentioned production traits. The genetic correlation of AFC with FLTMY , FLL and MY/FCI was positive that indicates lower AFC will decrease the performance of those traits. However its association with FCI and FL305Y was n*eg*ative indicating that much higher AFC also longer calving interval and first lactation 305 days milk yield.

Relationship with AFC with various first lactation production traits:

This was studied using r*eg*ression analysis and class interval method. Three r*eg*ression equation, liner quadratic and cubic were used. The results showed only 2.14 - 3.22% variation in different milk

Table 3 : Averages of first lactation production traits for different classes of age at first calving in Karan Fries cattle

AFC Classes	MY305 Mean ± SE (Kg)	%difference from lowest class	FLTMY MEAN ± SE (kg)	%difference from lowest class	MY/FLL Mean± SE (Kg)	%difference from lowest class	MY/FCI Mean ± SE (Kg)	%difference from lowest class
<791	2937.69 ± 92.07a (42)	-	3354.34 ± 135.23 (42)	-	9.74 ± 0.30a (39)	-	7.96 ± 0.30a (39)	-
791-830	3097.95 ± 71.83ab (69)	+ 5.45	3479.51± 104.75 (70)	+3.73	10.29 ± 0.23ab (68)	+5.64	8.55 ± 0.22ab (62	+7.41
831-910	3130.12 ± 53.37abc (125)	+6.55	3533.71±7 9.34 (122)	+5.34	10.23 ± 0.17 ab (117)	+ 5.03	8.62 ± 0.17ab (111)	+8.29
911-970	3241.05 ± 59.97 bcd (99)	+10.32	3602.46 ± 89.45 (96)	+7.39	10.62 ± 0.20bc (91)	+9.03	8.79 ± 0.19bc (82)	+10.42
971-1030	3186.79 ± 60.90 bcd (96)	+8.47	3523.38 ± 90.88 (93)	+5.04	10.33 ± 0.20ab (91)	+6.05	8.51 ± 0.20ab (80)	+6.90
1031-1090	3463.72 ± 80.46cd (55)	+17.90	3852.38 ± 120.38 (53)	+14.84	11.32 ± 0.27c (50)	+16.22	9.33 ± 0. 25c (48)	+17.21
1091-1150	3287.51 ±107.17 cd (31)	+11.90	3805.47 ± 165.62 (28)	+13.44	10.73 ± 0.38bc (25)	+10.16	8.69 ± 0.36 abc (24)	+9.17
> 1151	3207.33 ± 121.80 bcd (24)	+9.17	3790.06 ± 178.90 (24)	+ 13.25	11.14 ± 0.39bc (23)	+14.37	9.44 ± 0.40c (20)	+18.59

*Mean Subscripted by different letters differed significantly (P<0.05)

**Figuers in the parenthesis indicated the number of observations.

production traits were due to variation in AFC. Therefore only class interval method was used to find out the relationship between AFC with various production traits.

The AFC was classified into 8 different classes at 60 days interval &the average production performance of various classes were compared with respect to average performance group having lowest AFC. The results shows that the maximum average FL305Y, FLTMY, MY/FLL (3463.72+89.46 kg, 3852.38+129.38 kg and 11.32+9.27 kg respectively) was observed in cows whose AFC ranged from 911 to 970 days and lowest values found in cows having AFC below 701 days. For MY/FCI the highest value was observed in last AFC class *i.e* above 1151 days.

The DMRT result shows the highest average FL305Y had statistically non-significant difference with the average FL305Y of AFC class 851-910 days and above. The maximum numbers (23.18%) fall in 3rd AFC class also. The rate of change in milk production (FL305Y) with respect to change in AFC that there was gradual increase in milk production upto 1031-1090 days and beyond that FL305Y decrease. Increase in production with increase AFC might be proper physiological maturity and ductal growth of the mammary gland. However the decrease in production beyond this age group may be due to some reproductive less care and management which cause delayed maturity as well as lower production. Again the comparison between minimum & maximum average revealed that there was only 526 kg increase in milk yield for about 270 days increase in AFC. Here if only maximization of FL305Y is the criterion for selecting optimum range of AFC then 851 - 910 days looks to be optimum considering non-significant difference with highest group and maximum nos. (21.18%) of animals. AFC classes had non-significant effect on FLTMY. Considering the nos. of animals in different classes it is observed that 60% of animals had AFC below 970 days. As there was no significant increase in FLT MY beyond this class, effort should be made to restrict the AFC of cows of below 970 days. The trend in change of MY/FLL with the increase AFC was almost similar as FL305Y & FLTMY. The reason may be same as discusses earlier. The optimum AFC to maximize MY/FLL is to be selected on the basis of economic consideration. The average MY/FCI was found highest (9.44 ± 0.40 kg) in 8th AFC class (>1150 days) and significantly differed from 1st, 2nd , 3rd , 5th class but had non- significant different with 4th (911-979 days) in 8th AFC class Therefore 911-970 days AFC may be considered as optimum for maximizing MY/FCI as this group lowers AFC 210 days less in comparison to 8th class as well as non-significant difference with 8th class.

From the above discussion of four milk production traits it was observed that 911-1090 days was optimum for Karan Fries cattle. To select about 80% animals optimum range may be taken as 781 - 1091 days *i.e* 26-36 months. Singh and Chowdhury (1961) find optimum AFC 30-39 months for Sahiwal and 36-45 months for Tharparkar cattle. Jain and Dhillon (1975) found 28-37 months AFC was optimum for first lactation milk production in Sahiwal cattle, whereas ½ Friesian x SW and 5/8 Frision x SW cattle it was 28-30 months and the same was 29-31 months for ¼ HF x SW and ¾ Friesian x SW crossbreds. Reddy and Basu (1985) reported around 80 days AFC was optimum for maximum life time profit and hard life in crossbred cattle.

CONCLUSION :

The optimum level of AFC was identified based on higher milk production and number of animals in various classes. Optimum AFC was estimated as 26-36 months. However further research to be needed *i.e* to determine optimum range of economic traits more emphasis should be given as maximizing profit rather than maximizing production and proportion of culling of animal which fall in various reproductive classes should also be examined and

would be used for selection of optimum class.

REFERENCES :

Agasti MK, Chowdhury G and Dhar NL. (1988). Genetic studies on some of the traits of milk production in Hariana x Holstein crossbred cattle. Indian J. Anim. Hlth. 22: 133-137.

Becker WA. (1986). Mannual of Quantitative genetics Washington state Univ. Pullman. USA.

Draper NR and Smith H. (1981). Applied R*eg*ression Analysis. John Wiley and Sons. Inc. USA.

Garcha DS, Bajwa IS and Singh R. (1991). Genetic and non-genetic variations in some milk production efficiency traits in crossbred catlle . Asian J. Dairy Res. 19(1): 45-49.

Harvey WR. (1975). Least squares analysis of data with unequal subclass numbers. ARS. U.S.D.A. Washington D.C. p. 2-28.

Jadhav A. and Khan FA. (1996). Studies on age at first calving in Friesian x Sahiwal crosses. Indian Vet. J. 73(2) : 164-168.

Jain AK and Dhillon, JS. (1976). Optimum age and weight at first calving for milk production in Sahiwal and Holstein Friesian x Sahiwal crossbreds. Indian J. Dairy Sci. 29(4): 325-326.

Kramer CY. (1957). Extension of multiple range tests of group correlated means. Biometrics. 13 : 13-18.

Kumar G. (1992). Multiple trait sire evaluation with production and cat*eg*orical traits in cross bred cattle. Ph.D. Thesis. NDRI. Karnal.

Nagarcenkar R and Rao MK. (1982). Performance of Tharparkar exotic crosses for productive and reproductive traits. Indian J.Anim. Sci. 52(3): 129-138.

Nayak SK and Raheja KL. (1996). Performance of half bred and three breed cros0ses of Hariana with exotic dairy breeds. Indian J. Anim. Sci. 66(2) : 154-158.

Parmer OS, Jain AK and Gill GS. (1986). Evaluation to two breed and three breed cross breed cows with references to economic traits and production efficiency. Indian J. Dairy Sci. 39(3) : 210-214.

Patil RR, Singh G, Prasad M, Sharma RK and Dhaka BS. (1980). Milk yield of crossbred (Friesian x Sahiwal) cows in relation to age at first calving, lactation length, service period and dry period. Indian J. Dairy Sci. 33(4): 519-512.

Raheja KL. (1994). Genetic parameters for first lactation and lifetime production traits in Friesian x Hariana and Friesian-Sahiwal half breeds estimated by multiple traits maximum likelihood procedure. Indian J. Anim. Sci. 64(6) : 616-621.

Rao GN and Nagarcenkar R. (1992). Heritability estimates of body weight at different ages, first lactation traits and efficiency traits of milk production in Holstein Friesian crosses. India J.. Anim. Sci. 62(5) : 477-478.

Reddy CO and Basu SB. (1985). Factors affecting profit function and production traits in crossbred cattle. Indian J. Anim. Sci. 55(1) : 35-41.

Sachdeva GK and Gurnani M (1989). Evaluation of Friesian cross bred cattle genetic groups on the basis of total score. Indian J. Anim. Sci. 59: 1446-1447.

Singh R, Tomar SS and Sadana DK. (1988). Genetic analysis of age at first calving in Karan Fries cattle. Indian Vet. J. 65(5) : 407-411.

Singh MK. (1995). Factors affecting trends in performance of Karan Swiss and Karan Fries cattle. Ph.D. thesis. NDRI. Karnal.

Steel RGD and Torrie JH. (1980). Principles and procedures of statistics, a biometrical approach. 2nd edn. MC. Graw Hill International.

Su VV. (1988). Incidence of inbreeding and its effect on important economic traits of Karan Swiss and Karan Fries cattle. M.Sc. Thesis. Kurukshetra Univ. Kurukshetra, Hariyana, India.