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Association of Age at First Calving (AFC) on production trait in triple cross (Phule Triveni)

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Abstract
The average least squares mean of first lactation were FL300DMY 2377.17±36.51 kg, FLPMY 11.55±0.65 kg, FLL 316.19±2.43 days. The effect period of calving had significant effect on FL300DMY, FLPMY, FLL. Season of calving and age at first calving group had non-significant effect on all first lactation production trait.

Keywords: Production traits, Triple cross, Age at first calving, economic performance

Introduction
Our country possesses a large number of non-descript livestock population among poor genetic potential being milk production. To overcome this problem crossing of indigenous cattle among elite exotic breeds of cattle along with vigorous culling is the only remedy being improving genetic potential for milk production. In India, crossbreeding programme in cattle was started initially at military dairy farms and afterwards systematic crossbreeding was planned at six centres as All India Coordinate Research Project (AICRP) on Cattle since early seventies in different states including Maharashtra.

In Maharashtra, one of the project was started at Mahatma Phule Krishi Vidyapeeth, Rahuri. The Indian Council of Agriculture Research (ICAR) terminated this programme in 1986. Later on the AICRP on Cattle is designated as Research-Cum-Development Project (RCDP) on Cattle. This project take evolved Gir triple crossbred cattle (Phule Triveni synthetic cow) in the year 2000. Gir triple crossbred cattle (Phule Triveni synthetic cow) consists of 50% Holstein Friesian + 25% Jersey + 25% Gir inheritance. The Phule-Triveni synthetic cow is identified being better milk production potential (3200-3500 kg milk / lactation) with good fat content in milk (3.9-4.2%).

Average age at first calving has not been reduced much during the last decades because of the belief that early calving is harmful to milk yield and longevity (Pirlo *et al*., 2000). Although reduction of age at first calving is one of the most effective strategies for reducing replacement costs, most dairy farmers remain sceptical of calving heifers at ages less than 24 mo (Pirlo, 1997). Pirlo *et al*. (2000) reported that reduction of age at first calving has a negative effect on first-lactation milk yield and milk fat percentage.

The aim of this research was to study the age at first calving and their effect on production traits in triple cross.

Materials and Methods
For this study, utilizing the data maintained at Research Cum Development Project on Cattle (RCDP), Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.). The foundation stock of 300 Gir cows was inseminated among frozen semen of progeny tested sires of Holstein Friesian (HF) and Jersey (J) to generate FG and JG half breeds. The FG half breed was inseminated among the frozen semen of proven bulls of Brown Swiss (BS) and Jersey (J) to generate BFG and JFG crosses, respectively. Similarly, JG half breed were inseminated among the frozen semen of Holstein Friesian (HF) to generate FJG triple crossbred *i.e.* Phule Triveni (50% HF + 25% Jersey + 25% Gir).

Statistical analysis
Statistical analysis of data was carried out bottom the following headings

Least squares analysis

Least squares means of AFC was estimated by considering the effects of genetic (sire) and non-genetic factors (period and season of birth) by using following model.

$Y_{ijkl} = \mu + P_i + S_j + M_k + e_{ijkl}$

Where,

Y_{ijkl} = Observations on AFC of l^{th} animal belonging to i^{th}period of birth, j^{th}season of birth and k^{th} sire

μ = Overall mean

P_i = Fixed effect of i^{th} period of birth (I = 1, 2,…..7)

S_j = Fixed effect of j^{th}season of birth (j = 1,2 and 3)

M_k = Random effect of k^{th}sire (k= 1,2….n)

e_{ijkl} = Random errors associated with NID (O, σ_e^2)

Result and Discussion

The AFC is an important economic trait in dairy cows and genetic improvement being lowering AFC is desirable for reducing unproductive period, culling uneconomic animals at an early age and increasing their lifetime milk production. Such an improvement could only be brought about, firstly by knowing accurate magnitude of the AFC, its heritable fraction or variance and planning an appropriate selection system that can be adopted being achieving the desired goal**.**

Table 1: ANOVA of age at first calving as affected by genetic and non-genetic factors in Triple Cross

Source of variation	Mean sum of Squares (AFC)
Period of birth	806760.11**
Season of birth	18725.40
Sire	36696.87*
Error	28466.28

*p<0.05 and **p<0.01

The overall first squares mean of age at first calving in Triple cross (Phule Triveni) cows was 969.05±11.49 days. The similar value of least square means was observed by Jebale (1994), Bhoite (1996) [3], Jadhav (2011) [10] in Phule Triveni (Triple cross) cows.

a. Effect of period of birth

The period of birth was found to have significant (p<0.01) influence on AFC in Triple cross (Table-1). The difference in age at first calving of cows born during period P_4, P_5 and P_6 were at par with each other and significantly higher than cows born in P_1, P_2 and P_3 periods (Table-2). Similar results were reported by Singh *et al.* (2014) [18] and Rathee (2015) [18, 15] in Frieswal cattle.

b. Effect of season of birth

The influence of season of birth on age at first calving of Triple cross was non-significant. The highest age at first calving (days) was observed in heifers born during winter season (978.90±14.51) followed by summer (969.27±15.53) and rainy (958.97±15.86) season. These results were in agreement with Bhoite (1996) [3], Shinde (2010), Mukherjee (2005) [12] and Singh *et al.* (2014) [18] reported in HF crossbred cattle.

c. Effect of sire

The effect of sire on AFC was significant (P<0.05). The significant effect of sire on AFC was also reported by Jadhav (1990) [10] in HF x SW cattle, and Ambhore*et al.* (2017) [2] in Phule Triveni (Triple cross) cattle.

Table 2: Least squares means of age at first calving affected by various factors in Triple cross (Phule Triveni)

Factors	N	Mean ± SE
Overall (μ)	566	969.05±11.49
Period of birth		
Period -1 (1972-1978)	94	819.80±17.42^c
Period -2 (1979-1985)	152	887.25 ±13.70^c
Period -3 (1986-1992)	142	926.60±14.20^b
Period -4 (1993-1999)	84	1088.20±18.43^a
Period -5 (2000-2006)	49	1081.04±24.16^a
Period -6 (2007-2013)	38	1016.79±27.45^a
Season of Birth		
Rainy (S1)	170	958.97±15.86
Winter (S2)	213	978.90±14.51
Summer (S3)	183	969.27±15.53

2. First Lactation 300DMY

The milk yield is the basic and most important economic trait on which the whole economy of dairying is based. The FL300DMY provides most efficient measure to assess the inherent capacity of an individual and indicate the breeding value of a dairy animal accurately. Therefore, it taken been internationally agreed that the milk yield along first 300 days after calving be considered for comparison of production performance of dairy cattle.

The least squares mean of FL300DMYin Phule Triveni was 2377.171±36.51kg (Table-4). The present results were in consonance with the reports of Saha (2001) reported in Karan Fries and Shelke (2012) [17] and Ambhore *et al.* (2017) [2] in Phule Triveni cattle. Rathee (2015) [15] found higher estimates (3292.61 ± 53.6 kg) in Frieswal cattle.

a) Effect of period of calving

The analysis of variance showed a certain the period of calving had significant (p<0.01) effect on FL300DMY (Table-3). The DMRT revealed a certain the 300 days milk yield of cows calved during P_1 (3002.44± 94.51 kg) has significantly bigger than those calved in P_2 to P_6 period. The 300 days milk yield recorded during period P_3, P_4, P_5 and P_6 were at par with each other. The present results were in accordance with the reports of Saha (2001) [16], Annual Report, PDC (2003-04), Mukherjee (2005) [12], reported in various crossbreds.

b) Effect of season of calving

The influence of season of calving on 300 days milk yield has found to be non- significant in Phule Triveni cows. The non-significant effect of season of calving on FL300DMY was also reported by many workers (Rashia, 2010, Nehra, 2011 and Divya, 2012) [6] in KF cattle. Contrary to the present results, significant effect of season of calving on FL300DMY had been documented by Singh and Gurnani (2004) [19], Mukherjee (2005) [12], Rathee (2015) [15] in different crossbred cattle. The cows calved all along rainy season (2425.20±61.10 kg) had higher 300 days milk yield than winter (2321.13±55.43 kg) and summer season (2385.16±59.43 kg). However, the differences among different seasons were not statistically significant.

c) Effect of age at first calving group

The first squares study revealed that the AFC group had non-significant effect on FL300DMY (Table-3). Similar results were reported by Singh (1995), Panja (1997) [13] and Divya

(2012) [6] in KF cattle.

d) Effect of sire

Significant variation (P<0.05) due to sire was observed in FL300DMY in Phule Triveni (Table. 3). These results corroborated among the results of Ambhore *et al.* (2017) [2] in Phule Triveni cattle. However, Pol *et al.* (2013) [14] and Gaikwad (2010) [7] observed non-significant effect of sire on FL300DMY in Phule Triveni cow.

Table 3: ANOVA of various first lactation production traits as affected by genetic and non-genetic factors of Phule Triveni

Traits Source of Variations	Mean sum of Squares		
	FL300 DMY	FLPMY	FLL
Period of calving	8510796.10**	16.39**	44381.69
Season of calving	521884.17	0.79	1305.89
Age at first calving group	2824356.21	2.73	1128.12
Sire	661767.00*	1.99*	2962.19
Error	583906.28	1.86	2602.26

*P < 0.05 and ** P < 0.01

3. First suction peak milk yield

The overall first squares mean of FLPMY was 11.55 ± 0.65 kg (Table-4). Almost similar estimates of mean FLPMY were observed by Ambhore *et al.* (2017) [2] in Phule Triveni cattle, Saha (2001) [16] in KS cattle, Rasia *et al.* (2009) in KF cattle. However, Singh *et al.* (2008) [20] in HF x S crossbred, Nehra (2011) and Dash (2014) in KF cattle reported higher estimate of FLPMY. The difference in average FLPMY reported by many researchers may be attributed to difference in breeds used for crossing, herds, reproductive management strategies and time/ period considered.

a. Effect of period of calving

The effect of period of calving on FLPMY was significant (P<0.01). Similar result was reported by by Chavan (1995) [4] in FG and interse of FG halfbred, Singh (1995), Sivakumar (1998), Sahana and Gurnani (2000), Saha (2001) [16] in Karan Fries cattle, Chavan (2010) [4] in HF x Girhalfbred. However, Nehra (2011) in Karan Fries and Radhika *et al.* (2012) in HF crossbred reported non-significant effect. The highest FLPMY (12.14 ± 0.16 kg) was recorded during P1 (1974-1980) and the lowest (10.76 ± 0.19 kg) during P_6 (2007-2013). The DMRT revealed a certain the FLPMY recorded during period P_2, P_3, P_4, and P_5 was at par with each other. The results indicated that FLPMY gradually declined from cows calved during P_2 to P_6.

b. Effect of season of calving

The influence of season of calving on FLPMY was non-significant (Table-3). The first suction peak milk yield (Table.4) was highest (11.61 ± 0.10 kg) in summer calvers followed by rainy (11.56 ± 0.10 kg) and winter season (11.48 ± 0.09 kg) calvers. The non-significant effect of season of calving on first suction peak milk yield has reported byNikam (2010) in PhuleTriveni cows, Singh *et al.* (2008) [20] in HF x SW crossbred. However, significant effect of season of calving on FLPMY was observed by Bhoite (1996) [3], Kale*et al.* (2001), Mukharjee (2005) in Frieswal.

c. Effect of age at first calving group

The first squares study acknowledge that the age at first calving had non-significant effect on the FLPMY (Table-3).Similar to the present findings, Saha (2001) [16] and Nehra (2011) reported non-significant effect of AFC on FLPMY in KS and KF cattle, respectively. However, Sahana and Gurnani (2000) and Saha (2001) in KF cattle; Akhtar *et al.* (2003) [1] in HF x S and Mukherjee (2005) [12] in Frieswal cattle observed significant variation in FLPMY due to the age at first calving.

e) Effect of sire

Least-squares ANOVA revealed non-significant (P<0.05) variation due to sire in FLPMY (Table-3). Ambohre *et al.* (2017) observed non-significant effect of sire in Phule Triveni. While, Hadge *et al.* (2009) [8] reported significant (P<0.01) effect of sire on FLPMY in Sahiwal x Jersey crossbred cattle at Bull Mother Farm, Wadsa, District Gadchiroli (M.S.)

Table 4: Least squares mean (±SE) of first suction milk production traits of Phule Triveni

Factors	Number of Observation	FL300 DMY (kg)	FLPMY (kg)	FLL (days)
Overall (μ)	566	2377.171± 36.51	11.55± 0.65	316.19± 2.43
Period of calving				
Period -1 (1974-1980)	82	3002.44± 94.51^{a}	12.14± 0.16^{a}	340.94± 6.31
Period -2 (1981-1987)	162	2584.16± 62.94^{b}	11.99± 0.11^{b}	295.48± 4.20
Period -3 (1988-1994)	123	2446.97± 70.53^{c}	11.71± 0.12^{b}	302.56± 4.70
Period -4 (1995-2001)	95	2021.51± 81.06^{bc}	11.12± 0.14^{bc}	298.35± 5.41
Period -5 (2002-2008)	53	2090.50± 107.7^{bc}	11.59± 0.19^{b}	353.30± 7.19
Period -6 (2009 and above)	51	2117.42± 108.4^{bc}	10.76± 0.19^{c}	306.50± 7.24
Seasons of calving				
Rainy (S1)	170	2425.20± 61.10	11.56± 0.10	313.08± 4.07
Winter (S2)	213	2321.13± 55.43	11.48± 0.09	318.02± 3.70
Summer (S3)	183	2385.16± 59.43	11.61± 0.10	317.47± 3.96
Age group				
Age- 1 (< 900 days)	267	2293.87± 55.17	11.44± 0.09	319.09± 3.68
Age- 2 (901 – 1000 days)	126	2300.11± 71.49	11.52± 0.12	313.64± 4.77
Age -3 (1001 days and above)	173	2537.53± 61.89	11.70± 0.11	315.84± 4.13

4. First lactation length

The overall least-squares mean of FLL in Phule Triveni was 316.19 ± 2.43 days (Table-4). The estimate obtained in the present study was in close agreement among those reported by Saha (2001) [16] in KF cattle and Mukharjee (2005) and Kumar *et al.* (2008) in Frieswal.

a. Effect of period of calving

The difference due to period of calving in FLL was non-significant. The highest (353.30±7.19 days) FLL was

recorded in cows calved during P5(2002-2008) and lowest (295.48±4.20 days) calved during P2 (1981-1987). Similar results were noticed by Saha (2001) [16] and Akhtar *et al.* (2003) [1] in different HF crossbred cattle.

b. Effect of season of calving

The effect of season of calving on FLL was non-significant (Table-3). The highest FLL was recorded in calves calved during winter (318.02±3.70) and lowest (313.08 ± 4.07 days) calved during rainy season. The non-significant effect of season of calving on FLL observed in the present study was in agreement with Saha (2001) [16] in KF, Akhtar *et al.* (2003) [1] in 5/8 HF x 3/8 SW and Saha *et al.* (2010) in KF.

c. Effect of age at first calving group

The influence of AFC group on the FLL was found to be statistically non-significant (Table-3). It has apparent from the results a certain there was no much variation in FLL among the cows of different AFC groups. These results inline with the non-significant effect of AFC on FLL in different HF crossbred cattle was also noted by Saha (2001) [16], PDC AR (2003-04) and Nehra *et al.* (2011) in KF cattle.

d. Effect of sire

Least-squares ANOVA showed non-significant variation due to sire in FLL (Table-3). The results were inconsonance among Akhtar *et al.* (2003) [1] and Ambhore *et al.* (2017) [2] noticed in 5/8 HF x 3/8 SW and PhuleTriveni cattle, respectively.

Conclusion

Reducing age at first calving is an effective strategy for dairy farmers to reduce costs. Age at first calving can significantly affect production traits like, milk yield, total yield, lifetime, and productive life. High and multi-dimensional benefits due to reducing age at first calving and considering existing limitations, proper modification of rearing programs need to accommodate early calving in order to reap maximum benefits.

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