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Effect of Non-genetic Factors and Sire on Days to Attain Peak Milk Yield in Holdeo

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Abstract: *The data on milk production performance of 411 HF × Deoni crossbred having 1753 lactations were collected from records maintained at Cattle Cross Breeding Project, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) over a period of 38 years (1977 to 2014). The leasts squares mean of days to attain peak milk yield was estimated by considering effect of period of calving, season of calving, lactation order and age at first calving group and sire. The average days to attain peak milk yield of Holdeo cows were 36.48 ± 0.31 days. In Holdeo cows the variations due to period of calving, lactation order, age at first calving group and sire in days to attain peak milk yield were significant (P < 0.01). Whereas, season of calving shows non-significant effect.*

Keywords: *Holdeo, days to attain peak milk yield, period, season, lactation order, age at first calving group and sire.*

INTRODUCTION

Dairy sector is economically and socially very important in India due to the multi-functionality of dairy animals performing output, input, asset and socio-cultural functions. Cattle and buffalo are basically more important to our national economy among all livestock. The country would have achieved impressive level of milk production but controversies and constraints are hurdles in dairy development. Milk production is dominated by small producers with an estimated 70 million rural milk producer households in the country of which about 75 per cent are landless and marginal farmers, typically owning between 1-3 animals and contributes about 70 per cent to the total milk production.

MATERIALS AND METHODS

Collection of Data

The observations pertaining to days to attain peak milk yield for Holdeo (Holstein Friesian × Deoni) crossbred cattle were collected from history cum pedigree sheets over a period of 38 years (1977 to 2014) maintained at Cattle Cross Breeding Project, Vasantrao Naik Marathawada Krishi Vidyapeeth, Parbhani.

Classification of Data

The data collected on days to attain peak milk yield were classified in suitable sub-class frequency and were subjected for correction. The collected data of days to attain peak milk yield were classified according to the period of calving, season of calving, lactation order and age at first calving group.

Period of Calving

Entire span of 38 years (1977 to 2014) were divided into 5 periods

Sr. No.	Years	Period
1.	< 1980-1986	P_1
2.	1987-1993	P_2
3.	1994-2000	P_3
4.	2001-2007	P_4
5.	2008-2014	P_5

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Season of Calving

The year was divided into three seasons based on climatic conditions such as

Sr. No.	Month	Season	Code
1.	June-September	Rainy	S_1
2.	October-January	Winter	S_2
3.	February-May	Summer	S_3

Lactation Order

The lactation orders were considered up to 11th lactation orders and coded as

Sr. No.	Lactation orders	Code
1.	1st	L_1
2.	2nd	L_2
3.	3rd	L_3
4.	4th	L_4
5.	5th	L_5
6.	6th	L_6
7.	7th	L_7
8.	8th	L_8
9.	9th	L_9
10.	10th	L_{10}
11.	11th	L_{11}

Age at First Calving Group

The age at first calving were classified into following five groups

Sr. No.	AFC (days)	Code
1.	Up to 1250	A_1
2.	1251 to 1400	A_2
3.	1401 to 1550	A_3
4.	1551 to 1700	A_4
5.	Above 1700	A_5

STATISTICAL ANALYSIS

Least Squares Analysis

Analysis of data was carried out by using Least Squares analysis method for non-orthogonal data as described by Harvey (1990) and by using the Statistical Analysis System (SAS, 2002) software programme.

The following models were used :

Model I

The least squares means of days to attain peak milk yield was estimated by considering effect of period of calving, season of calving, lactation order and age at first calving group. The model used for estimation was as under;

$$Y_{ijklm} = \mu + P_i + S_j + L_k + A_l + e_{ijklm}$$

Where,

Y_{ijklm} = Observations on days to attain peak milk yield of m^{th} animal belonging to i^{th} period of calving, j^{th} season of calving, k^{th} lactation order and l^{th} age at first calving group

μ = Population mean

P_i = Effect of i^{th} period of calving (i = 1, 2 – 5)

S_j = Effect of j^{th} season of calving (j =1, –3)

L_k = Effect of k^{th} lactation order (k = 1, 2 – 11)

A_l = Effect of l^{th} age at first calving group (l = 1 – 5)

e_{ijkl} = Random error associate with NID (0, $\sigma^2 e$)

Model II

The least squares means of days to attain peak milk yield was estimated by considering effect of sire. The model used for estimation was as under;

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where,

Y_{ij} = Observations on days to attain peak milk yield of j^{th} individual belonging to the i^{th} sire

μ = Population mean

S_i = Effect of i^{th} sire (i = 1, 2 – 68)

e_{ij} = Random error associate with NID (0, $\sigma^2 e$)

Duncan's Multiple Range Test (DMRT)

Whenever the effects were significant the differences between means were tested for significance by Duncun's Multiple Range Test (DMRT) as modified by Kramer (1957) to make pair wise comparison between the Least Squares means (using the inverse coefficient matrix). If the values are greater than $\sigma^2 e$, ZP, n_2 then the difference is considered to be significant. The difference was considered if

$$X_i - X_j = SQRT\,[2/(C_{ii} + C_{jj} - 2C_{ij})] > \sigma^2 eZPn_2$$

Where,

$X_i - X_j$ = Difference between the two least squares mean

Cii = Corresponding i^{th} diagonal element of C matrix

Cjj = Corresponding j^{th} diagonal element of C matrix

Cij = Corresponding $(i, j)^{th}$ element

ZPn_2 = Standardized range value in Duncan's table of the chosen level of probability for the error degree of freedom

P = Number of means involved in the comparison

$\sigma^2 e$ = Root means squares for error

RESULT AND DISCUSSION

Days to Attain Peak Milk Yield

The least squares mean and analysis of variance of days to attain peak milk yield affected by non-genetic factors in Holdeo cows were presented in Table 1 and 2, respectively. The average number of days required to attain peak milk yield in Holdeo cows was 36.48 ± 0.31 days. Closer values of days to attain peak milk yield reported by Deshpande and Singh (1977), Kakde *et al.* (1980), Salunkhe (2007) and Jagdale (2015) in Deoni cattle, Pathak and Dhingara (1989) in Gir, Ramchandraiah (1990) and Deokar and Ulmek (2001) in Jersey cattle, Kulkarni (2001) in Red Sindhi, Bhopale (2008), Anarase (2011), Bhutkar (2014), Ambhore (2015) and Pawar (2015) in Holstein Friesian × Deoni crossbred and Tambe (2016) in HF × Gir halfbred.

1. Effect of period of calving

In Holdeo cows the variations due to period of calving in days to attain peak milk yield was significant ($P < 0.01$). These results were in consonance with Agasti *et al.* (1988) reported in Jersey × Hariana cattle, Garcha *et al.* (1989) in HF × Sahiwal crossbred, Singh *et al.* (1989) in FH, BH, JH halfbreds, Gogoi *et al.* (1993) and Kulkarni (2001) in Red Sindhi cows, Nanavati and Qureshi (1996) in Gir cattle, Gawari (1999) in FJG, BFG and JFG triple cross cows, Salunkhe (2007) and Jagdale (2015) in Deoni cattle, Garudkar (2011) and Shelke (2012) in

Table 1
Least squares means for days to attain peak milk yield (days) as affected by non-genetic factors in Holdeo

Source of variation	*Code*	*N*	*DAPY (days) Mean ± S.E*
Overall mean	μ	1753	36.48 ± 0.31
Period of calving	P_1	516	35.90^{ab} ± 0.39
	P_2	605	36.15^{ab} ± 0.34
	P_3	341	36.58^{ab} ± 0.37
	P_4	153	35.32^{b} ± 0.47
	P_5	138	38.46^{a} ± 0.47
Season of calving	S_1	509	36.51 ± 0.35
	S_2	699	36.61 ± 0.34
	S_3	545	36.32 ± 0.36
Lactation order	L_1	411	37.63^{ab} ± 0.24
	L_2	341	37.08^{ab} ± 0.26
	L_3	258	36.77^{ab} ± 0.30
	L_4	213	36.80^{ab} ± 0.33
	L_5	177	36.93^{ab} ± 0.36
	L_6	147	36.32^{bc} ± 0.39
	L_7	103	36.11^{b} ± 0.46
	L_8	59	36.23^{bc} ± 0.61
	L_9	30	38.59^{a} ± 0.84
	L_{10}	11	34.80^{c} ± 1.39
	L_{11}	3	34.01^{c} ± 2.67
AFC groups	A_1	443	36.55^{ab} ± 0.36
	A_2	176	36.21^{ab} ± 0.45
	A_3	537	36.16^{ab} ± 0.35
	A_4	436	35.84^{b} ± 0.36
	A_5	161	37.64^{a} ± 0.47

Means with similar superscripts are not differ significantly.

Table 2
Analysis of variance for DAPY in Holdeo

Source of variation	*df*	*SS*	*MSS*	*F value*
Period of calving	4	827.96	206.99	9.74^{**}
Season of calving	2	26.08	13.04	0.61
Lactation order	10	508.27	50.82	2.39^{**}
AFC groups	4	413.73	103.43	4.86^{**}
Error	1732	36790.48	21.24	
Total	1752	38566.54	22.01	

** = $P < 0.01$

Phule Triveni synthetic cows, Khadda *et al.* (2012) in Tharparkar cattle, Kumar *et al.*(2012) in Sahiwal cattle, Patond (2013) in Gir triple cross cows, Bhutkar (2014) in Holstein Friesian × Deoni crossbred and Tambe (2016) in HF × Gir halfbred.

In present study the cows calved during P_5 (38.46 ± 0.47), P_1 (35.90 ± 0.39), P_2 (36.15 ± 0.34) and P_3 (36.58 ± 0.37) required significantly higher days to attain peak yield (days) than cows calved during P_4 (35.32 ± 0.47). The differences in DAPY among cow calved during P_1, P_2 and P_3 and P_5 periods were at par with each other.

2. *Effect of season of calving*

In Holdeo cows the differences due to season of calving in days to attain peak milk yield was non-significant. These results were in agreement with the results of Raheja (1982) observed in Hariana cattle, Rao and Sunderson (1992) in Holstein Friesian × Sahiwal cattle, Nanavati and Qureshi (1996) in Gir cattle, Salunkhe (2007), Bhutkar (2014) and Jagdale (2015) in Deoni cattle, Thombre *et al.* (2002), Bhutkar (2014), Ambhore (2015) and Pawar (2015) in Holstein Friesian × Deoni crossbred, Garudkar (2011) in Phule Triveni synthetic cows, Khadda *et al.* (2012) in Tharparkar, Kumar *et al.*(2012) in Sahiwal and Tambe (2016) in HF × Gir halfbred. The winter calved cows required significantly more days to reach peak milk yield and lowest in summer calved cows.

3. *Effect of lactation order*

In Holdeo cows the difference due to lactation order in days to attain peak milk yield was significant (P < 0.01). Similar results reported by Singh and Shukla (1986) reported in Gir cows, Ramchandraiah *et al.* (1990) in Jersey cattle, Kulkarni (2001) in Red Sindhi cows, Aksakal *et al*. (2010) in Swedish red and white cattle, Patond (2013) in Gir triple cross cows and Ambhore (2015) in Holstein Friesian × Deoni halfbred. The days to attain peak milk yield (days) of cows calved during L_9, L_1, L_2, L_3, L_4 and L_5 were significantly higher which were at par with each other than L_6, L_7, L_8, L_{10} and L_{11} lactations.

4. *Effect of age at first calving group*

In Holdeo cows influence of age at first calving group on days to attain peak milk yield was significant (P < 0.01). These results supported by Agasti *et al.* (1988) observed in Jersey × Hariana crossbred, Ramchandraiah *et al.* (1990) in Jersey cows, Shelke (2012) in Phule Triveni Synthetic cows, Patond (2013) in Gir triple cross cows and Bhutkar (2014) in Deoni cows. The days to attain peak milk yield (days) of cows of A_5, A_1, A_2 and A_3 group were significantly higher than A_4 group. The difference in DAPY (days) between cows of A_5, A_1, A_2 and A_3 group which did not differed from each other.

5. *Effect of sire*

The analysis of variance indicating effect of sire on days to attain peak milk yield and means of days to attain peak milk yield were presented in Table 3 and 4, respectively. In Holdeo cows the effect of sire on days to attain peak milk yield was significant (P < 0.01). These results were in accordance with Patond (2013) observed in Gir triple cross cows and Tambe (2016) in HF × Gir halfbred. The highest mean DAPY was observed in cows of sire B_{63} (44.67 ± 1.59 days). However, lowest values was observed in cows of sire B_{68} (30.05 ± 3.19 days).

Table 3
Days to attain peak yield in Holdeo as affected by sire

Sire code	*N*	*DAPY (days) Mean ± S.E*	*Sire code*	*N*	*DAPY (days) Mean ± S.E*
μ	1753	36.27 ± 0.24	B_{35}	15	35.78 ± 1.16
B_1	165	36.70 ± 0.35	B_{36}	23	35.50 ± 0.94
B_2	163	36.59 ± 0.35	B_{37}	5	37.30 ± 2.01
B_3	124	35.98 ± 0.40	B_{38}	54	37.53 ± 0.61
B_4	135	35.97 ± 0.38	B_{39}	5	33.12 ± 2.01
B_5	16	36.79 ± 1.12	B_{40}	9	35.95 ± 1.50
B_6	8	37.77 ± 1.59	B_{41}	7	34.97 ± 1.70
B_7	26	39.60 ± 0.88	B_{42}	13	35.92 ± 1.25
B_8	6	35.60 ± 1.84	B_{43}	11	36.49 ± 1.36
B_9	5	38.30 ± 2.01	B_{44}	8	36.41 ± 1.59
B_{10}	11	36.95 ± 1.36	B_{45}	9	39.58 ± 1.50
B_{11}	9	35.59 ± 1.50	B_{46}	2	36.30 ± 3.19
B_{12}	32	36.07 ± 0.79	B_{47}	6	37.33 ± 1.84
B_{13}	59	35.53 ± 0.58	B_{48}	4	38.70 ± 2.25
B_{14}	23	36.20 ± 0.94	B_{49}	2	36.95 ± 3.19
B_{15}	21	38.25 ± 0.98	B_{50}	4	32.36 ± 2.25
B_{16}	115	36.26 ± 0.42	B_{51}	3	33.40 ± 2.60
B_{17}	50	36.66 ± 0.63	B_{52}	1	37.43 ± 4.51
B_{18}	66	37.73 ± 0.55	B_{53}	6	32.94 ± 1.84

Cont. table 3

Sire code	N	DAPY (days) Mean ± S.E	Sire code	N	DAPY (days) Mean ± S.E
B_{19}	11	36.51 ± 1.36	B_{54}	4	33.15 ± 2.25
B_{20}	54	35.74 ± 0.61	B_{55}	3	37.93 ± 2.60
B_{21}	133	35.82 ± 0.39	B_{56}	3	34.82 ± 2.60
B_{22}	18	36.58 ± 1.06	B_{57}	1	34.14 ± 4.51
B_{23}	3	35.16 ± 2.60	B_{58}	3	34.80 ± 2.60
B_{24}	82	37.46 ± 0.49	B_{59}	2	33.93 ± 3.19
B_{25}	9	35.85 ± 1.50	B_{60}	3	33.34 ± 2.60
B_{26}	2	34.89 ± 3.19	B_{61}	1	33.46 ± 4.51
B_{27}	7	37.16 ± 1.70	B_{62}	5	42.72 ± 2.01
B_{28}	67	36.32 ± 0.55	B_{63}	8	44.67 ± 1.59
B_{29}	9	34.31 ± 1.50	B_{64}	1	35.35 ± 4.51
B_{30}	12	36.07 ± 1.30	B_{65}	11	37.62 ± 1.36
B_{31}	43	36.28 ± 0.68	B_{66}	6	41.56 ± 1.84
B_{32}	10	34.65 ± 1.42	B_{67}	8	35.57 ± 1.59
B_{33}	6	36.47 ± 1.84	B_{68}	2	30.05 ± 3.19
B_{34}	5	37.46 ± 2.01			

Table 4
Least squares analysis of variance of DAPY as affected by sire in Holdeo

Source of variation	df	SS	MSS	F value
Sire	67	2452.83	36.60	1.79^{**}
Error	1685	34337.64	20.37	
Total	1752	36790.48	20.99	

** = $P < 0.01$

CONCLUSIONS

The highly significant effect of period of calving on days to attain peak milk yield indicated the response of animals to varied environmental conditions including feeding, management and changing population dynamics. The significant effect of lactation order on days to attain peak milk yield attributed due to physiological maturity and development of body with advancing age of the cows. The better production performance of progenies may be due to its superior genetic potentiality.

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