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Effect of certain factors on first lactation peak yield and days to attain peak yield in frieswal cattle

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In India, crossbreeding has been practiced since 1875 by breeding the indigenous females with the temperate dairy breeds for increasing the milk production. Frieswal (Holstein Friesian X Sahiwal) is one of the crossbred dairy cattle being evolved by the ICAR- Central Institute for Research on Cattle (Formerly Project Directorate on Cattle), Meerut, India in collaboration with Ministry of Defence for higher milk production. The crossbred cattle maintained at military farms located in various agro climatic regions of the country having 62.50±5.00 per cent of exotic blood level is known as Frieswal cattle. The genetic evaluation of Frieswal cattle is mainly done of the basis of their milk production and superior animals are selected for improving the production. The peak yield (PY) and days to attain peak yield (DAPY) are two economically important traits which provide an early proof on the true milk production potential of dairy animals as their genetic correlation with the lactational milk yield is always found to be high. The PY and DAPY also play an important role in determining the persistency of milk production and the shape of lactation curve. Early selection of animals for milk production on the basis of these traits would also reduce the generation interval thereby increase the genetic gain per unit of time. Perusal of available literature revealed no scientific information on the PY and DAPY in Frieswal cattle. In view of the above facts the present study was undertaken to estimate the effect of certain factors like farm, period, season and sire on the PY and DAPY in Frieswal cattle.

The data for the study was collected from two different military dairy farms viz., Meerut and Ambala. A total of 9957 daily milk yield records of 1073 Frieswal cows calved during 2005 to 2014 were collected and utilized for the study. Additional information on the date of birth, sire, dam, date of calving, date of drying etc. were also collected from the history cum pedigree sheets of the animals. The information on peak yield and days to attain peak yield were generated from the daily milk yield records. In order to study the effect of different factors, the recorded data were classified according to the farm, sire, season and period of calving. The data included the information on cows maintained at Meerut and Ambala farms sired by 90 bulls. On the basis of temperature, humidity and rainfall, the year of calving was divided in to three seasons viz., winter (Nov-Feb), summer (Mar-Jun) and rainy (Jul-Oct). The 10 years of study period was divided into five groups of two consecutive years viz., 2005–06, 2007–08, 2009–10, 2011–12 and 2013–14. The influence of various factors on the PY and DAPY was estimated by least squares analysis of variance for unequal non-orthogonal data using the GLM model of SPSS (Version 20). The statistical model used was as follows:

$$Y_{ijklm} = \mu + F_i + P_j + S_k + B_l + e_{ijklm}$$

Where,

Y_{ijklm} = dependent variables i.e. PY or DAPY
μ = Overall mean
F_i = Effect of i^{th} farm
P_j = Effect of j^{th} period of calving
S_k = Effect of k^{th} season of calving
B_l = Random effect of l^{th} sire
e_{ijklm} = Random error, assumed to be normally and independently distributed with mean zero and constant variance *i.e.* NID (0, σ_e^2)

Duncan's multiple range test as modified by Kramer (1957) was used for testing the statistical significance of differences among least squares means (using the inverse coefficient matrix).

The results of least squares analysis of variance on the effect of various factors on PY and DAPY are presented in table-1. The factors included in the models for PY and DAPY accounted for 10.30 and 12.00 per cent of the total variations, respectively.

Peak yield is defined as the maximum total yield obtained at any day of the lactation. The least squares analysis of variance revealed that the period of calving had highly significant (P<0.01) effect on the first lactation peak yield while the differences due to other factors viz., farm, sire and season of calving were statistically not significant. The variation in PY due to farm was the least significant

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Table 1. Least squares analysis of variance (mean squares only) for peak yield (kg) and days to attain peak yield in Frieswal cattle

Traits	Farm (1)	Period (4)	Season (2)	Sire	Error	R^2- value (%)
Peak yield	0.008	61.554**	32.523	12.538 (90)	13.936 (973)	10.30
Days to attain peak yield	2325.984	709.235	8128.314**	841.384 (82)	905.960 (799)	12.00

Figures in parentheses indicate the degrees of freedom; ** significant at 1% level (P≤0.01)

followed by the sire and season of calving (Table 1).The significant effect of period of calving on PY was also reported by Subha Lakshmi *et al*. (2009) in Holstein Friesian X Sahiwal cattle, Patond *et al*. (2013) in Jersey cattle. Contrary to the present findings, Subha Lakshmi *et al.* (2009) in Holstein Friesian X Sahiwal cattle and Taher (2012) in Friesian cattle reported significant effect of season of calving on peak yield. However, Rao and Sundaresan (1982) in HF × Sahiwal cattle and Patond *et al.* (2013) in Jersey cattle reported non-significant effect of season of calving on peak yield which corroborated the results obtained in the present study. The non-significant effect of season of calving on peak yield suggested that the Frieswal cows express their full genetic potential for daily yield during the lactation irrespective of the season of calving. The study also revealed that the peak yield of animals maintained in two different farms viz., Ambala and Meerut were almost similar. The effect of sire on peak yield was found to be non-significant indicating that all the sires had similar genetic potential for peak yield, in other words, all the sires had similar breeding values for peak yield.

The overall least squares mean for PY in Frieswal cattle was estimated as 13.86±0.27 kg which was slightly higher than the average PY estimate of 13.30 kg reported by Subha Lakshmi *et al.* (2009) in a limited number of Holstein Friesian X Sahiwal crossbred cattle.The average PY of Frieswal cows was also superior to the estimates of 13.10 and 13.36 kg reported by Patond *et al*. (2013) and Ramchandraiah *et al.* (1990) in Jersey cattle, respectively. Roy and Katpatal (1998) reported even lower estimate of 11.88 kg in Jersey cattle while Taher (2012) reported a slightly higher average PY of 14.25 kg in Friesian breed of cattle. The average peak yields of Frieswal cows maintained at Meerut (13.85 kg) and Ambala (13.86 kg) farms were nearly same and comparable with that of pure Friesian as reported by Taher (2012). In general, the animals calved during winter season had the highest peak yield of 14.14 kg, while the rainy calvers had the lowest yield of 13.46, kg, however, the differences due to season were not statistically significant. The least squares averages of peak yield during different periods showed that the animals calved during 2009–10 had the highest peak yield of 14.87 kg, while the animals calved during 2007–08 had the lowest peak yield of 12.94 kg.

The overall average days to attain peak yield was estimated as 46.60 days±2.29 days (Table–2). Similar to the present findings, Taher (2012) reported average DAPY estimate of 47.53 days in Friesian cattle. Contrary to the present findings, Patond *et al.* (2013) reported a lower estimate of 21.41 days in Jersey cattle. The least squares analysis of variance revealed that only the season of calving had highly significant (P<0.01) effect on DAPY, while period of calving had the lowest non-significant effect followed by sire and farm. The significant effect of season of calving on DAPY was also reported by Singh *et al.* (1989) in Hariana halfbreds with HF, Jersey and BS cattle, Taher (2012) in Friesian cattle and Patond *et al.*(2013) in Jersey cattle. The average DAPY of rainy (52.40 days) calvers were highest followed by winter (47.18 days) and summer (40.24 days) calvers. These results suggested that the animals calved during rainy season had taken more time to express their full genetic potential for milk production than the summer and winter calvers. This might be due to the fact that during the rainy season (July to October), the Frieswal cows were under thermal stress due to increased ambient temperature and humidity and the cows calved during rainy season might have diverted their energy to combat the thermal stress and so could not produce the maximum daily yield but once they enter the winter season (November-February) they express their full genetic potential for milk yield as the environment is favourable. However, by the time the rainy calvers enter into the winter season, their peak stage of production might have ceased

Table 2. Least squares means for peak yield (kg) and days to attain peak yield in Frieswal cattle

Overall	Peak yield		Days to attain peak yield	
	No.	Mean ± SE	No.	Mean ± SE
	1071	13.86±0.27	889	46.60±2.29
		Farm		
Ambala	300	13.86±0.37	231	42.96±3.32
Meerut	771	13.85±0.38	658	50.25±3.13
		Period of calving		
2005-06	42	$13.81±0.73^{bc}$	37	49.66±6.37
2007-08	185	$12.94±0.46^{a}$	156	44.90±3.94
2009-10	299	$14.87±0.34^{c}$	229	49.12±2.97
2011-12	267	$14.10±0.39^{bc}$	234	46.81±3.37
2013-14	278	$13.56±0.47^{ab}$	233	42.54±3.97
		Season of calving		
Winter (Nov-Feb)	470	14.14±0.30	405	$47.18±2.51^{b}$
Summer (Mar-Jun)	378	13.97±0.31	307	$40.24±2.66^{a}$
Rainy (Jul – Oct)	223	13.46±0.36	177	$52.40±3.16^{c}$

Means bearing same superscripts did not differ significantly

due to the normal physiological process of lactation and so could not produce the peak yield as higher as the winter calvers. On the contrary, the summer calvers reached their peak yield at the earliest of 40.24 days and this result was as expected because, the animals calved during summer next entered in to the rainy season during which the animals were exposed to extreme climatic conditions which reduced the production potential of the animals. So, the summer calvers reached their peak during the summer season itself which resulted in the lowest DAPY as compared to the rainy calvers. The winter calvers produced the highest peak yield and had medium DAPY indicating that they are in their comfortable zone during the early and mid-stage of lactation i.e. winter and summer seasons.

The period of calving had non-significant effect on DAPY in Frieswal cattle. Similar to the present findings Patil (1989) in HF X Gir cattle, Patond *et al.* (2013) in Jersey cattle also reported non-significant effect of period of calving on DAPY. Perusal of table-2 revealed that the DAPY had decreased over the years from 49.66 days during 2005–06 to 42.54 days during 2013–14. The effect of sire and farm also did not affect the DAPY significantly.

Based on the results obtained in the present study, it may be concluded that the period of calving and season of calving significantly ($P<0.01$) altered the PY and DAPY, respectively in Frieswal cattle. However, the farm and sire effects were not statistically significant in altering the two traits in Frieswal cattle. The winter calvers had the lowest PY and longest DAPY while the summer calvers had the shortest DAPY and winter calvers had the highest PY in Frieswal cattle. The study also revealed that the thermal stress due to increased ambient temperature and humidity during the rainy season severely affected milk yield and the Frieswal animals were comfortable during the winter season for higher milk production.

SUMMARY

The effect of certain factors, viz. farm, sire, season and period of calving on first lactation peak yield (PY) and days to attain peak yield (DAPY) was assessed in Frieswal cattle. A total of 9957 daily milk yield records of 1073 Frieswal cows sired by 90 bulls maintained at Meerut and Ambala military farms and calved during the period from 2005 to 2014 were utilized for the study.The data were analysed using the least squares analysis of variance for unequal non-orthogonal data using the GLM of SPSS (Version 20).The overall least squares averages for PY and DAPYwere estimated as 13.86±0.27 kg and 46.60 days, respectively in Frieswal cattle and the factors included in the models accounted for 10.30 and 12.00 per cent of the total variations, respectively.The least squares analysis revealed highly significant effect of period of calving ($P<0.01$) on PY and season of calving on DAPY. The rainy calvers had the lowest PY and longest DAPY while the summer calvers had the shortest DAPY and winter calvers had the highest PY in Frieswal cattle. The study also revealed that the thermal stress due to increased ambient temperature and humidity during the rainy season severely affected milk yield and the Frieswal animals were comfortable during the winter season and produced higher milk yield.

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