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Certain factors affecting first lactation individual monthly milk yields in Frieswal cattle*

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Frieswal is one of the superior crossbred cattle developed in India by crossing the indigenous milch breed with the temperate dairy breed. The Frieswal project was started on 23rd May, 1985 by the Indian Council of Agricultural Research in collaboration with the Ministry of Defence, Government of India for developing a strain of cattle by crossing the Sahiwal cattle with the Holstein Friesian bulls. The traditional genetic evaluation of Frieswal bulls based on the first lactation 305-days or less milk yield of their daughters increases the generation interval thereby reducing the genetic gain per unit of time and increasing the cost of sire evaluation. Under Indian farm conditions, very few daughters complete their first lactation and most of the daughters with incomplete records are eliminated from the evaluation programme which causes biasness in the sire evaluation and indirectly reduces the accuracy of selection. Thus, the part lactation records of daughters can be used for genetic evaluation of Frieswal sires to select the bulls at younger age. It will also help in increasing the intensity of selection due to the availability of more number of records on daughters even having part lactation records in addition to reducing the generation interval and cost of evaluation. In view of the above facts, the present study was undertaken to assess the effect of various genetic and non-genetic factors on first lactation individual monthly milk yields in Frieswal cattle.

The data on 442 Frieswal cows born to 30 sires maintained at Military Dairy Farm, Meerut over a period of eight years (2006–2013) were utilized for the present study. The individual monthly part yields were calculated by adding the daily milk yield at an interval of 30 days from 6th day to 305-day of lactation. The colostrum yield for the first five days after calving was not added to calculate the monthly yields. The records of the animals with known pedigree and normal lactation were only considered for this study. The records of animals with less than 400 kg of milk production or less than 100 days of lactation length were also discarded. To ensure the normal distribution, the outliers were removed and data within the range of mean ± 2SD were only considered for the study. The sire was considered as the genetic factor while the season of calving and period of calving were considered as the non-genetic factors.The age at first calving was taken as the covariate of the part lactation yield to study the regression of part yields on it. According to the year of calving, the total duration of the present study was divided into four periods of two consecutive years and each year was divided into three seasons namely winter (November –February), summer (March-June) and rainy (July-October).

The least squares analysis of variance for unequal non-orthogonal data as described by Harvey (1979) was used to study the effect of various genetic and non-genetic factors on first lactation individual monthly yields in Frieswal cattle and was carried out using the SAS (2002).The statistical model used is as follows:

$$Y_{ijkl} = \mu + S_i + P_j + A_k + b_z (Z_{ijkl} - Z) + e_{ijkl}$$

where, Y_{ijkl}, individual monthly part lactation yield of cow of i^{th} sire calved in k^{th} season and j^{th} period; μ, overall mean; S_i, effect of i^{th} sire; P_j, effect of j^{th} period; A_k, effect of k^{th} season; b_z, regression coefficient of individual monthly yields on age at first calving, Z_{ijkl}, age at first calving taken as covariable; Z, average age at first calving; e_{ijk}, random error, assumed to be normally and independently distributed with mean zero and constant variance i.e. NID (0, σ_e^2).

The Duncan's multiple range test as modified by Kramer (1957) was used to test the differences among least squares means of a particular factor (using the inverse coefficient matrix).

The results of the least squares analysis of variance for different individual monthly part lactation records are given in Table 1. The model developed for first to tenth individual month yields accounted for 14.5, 13.2, 10.7, 8.6, 9.7, 10.8,

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Table 1. Least squares analysis of variance (Mean squares only) for various individual monthly milk yields in Frieswal cattle

Trait	Sire	Season	Period	AFC	Error	R^2 value (%)
1st Month	8255.796	5983.168	27785.680	150546.760**	9735.216 (404)	14.50
2nd Month	11235.671	21087.596	12837.080	191414.068**	12351.304(405)	13.20
3rd Month	8036.780	5552.528	11683.581	173560.782**	11719.203(405)	10.70
4th Month	8411.062	4690.024	9460.457	149939.816**	13423.738(406)	08.60
5th Month	7227.192	11122.132	2970.703	133044.369**	133044.369(406)	09.70
6th Month	8006.804	8756.591	4660.322	135220.001**	10095.206(404)	10.80
7th Month	6002.085	16594.398	13394.917	66686.466**	8573.064(394)	10.50
8th Month	5965.115	39963.894*	15847.150	9398.867	10054.628(382)	09.60
9th Month	9221.315	42589.720*	41378.404*	4482.999	9358.771(312)	13.80
10th Month	6142.522	24787.321*	3243.560	2809.191	6753.784(248)	13.20

Figures in parentheses indicate the degrees of freedom, **significant at 1% level (P< 0.01), *significant at 5% level (P< 0.05).

10.5, 9.6, 13.8 and 13.2% of the total variation, respectively. The number of records for different individual monthly yields varied due to the differences in the lactation length of the cows.

The overall least squares averages for first to tenth monthly yields were estimated as 313.92, 347.53, 337.36, 323.32, 305.50, 288.26, 269.47, 236.35, 229.84 and 158.23 kg, respectively (Table–2) in the first lactation of Frieswal cows. The average yields obtained for different months were nearer to the values reported by Singh (2006) in Karan Fries cattle. However, the monthly averages obtained in the present study were higher than the estimates reported by Kumar (1990), Varshney and Tomar (1982), Shrivastava and Khan (1987), Raja (2012) and Mundhe *et al.* (2015) in Sahiwal cattle. Similarly, the estimates were also higher than the average individual monthly yields of Jersey and Holstein Friesian cattle in Asom as reported by Das *et al.* (2006). The results also revealed that the average individual monthly milk yield was highest at second month of lactation and thereafter showed a gradual decline in the monthly milk production. Roy *et al.* (2001) and Mundhe *et al.* (2015) also reported similar trend of highest 2nd month milk yield followed by a gradual decline till 10th month of lactation in Holstein Friesian and Sahiwal cattle, respectively.

The least squares model used in the study consisted of the sire, season and period of calving in addition to the covariable effect of age at first calving. The analysis of variance revealed that the effect of sire did not alter the any of the individual monthly milk yield of their daughters significantly indicating that the sires used for breeding had more or less similar genetic potentiality for milk production. Generally, the Frieswal cows maintained at the Military Farms are bred with the high ranked proven progeny tested bulls so that their daughters produce higher milk yield. Hence, the result obtained above was as expected because of the use of the bulls having similar genetic potential for milk production.

The study also revealed that the season had statistically significant effect (P<0.05) only on the later stages of lactation i.e. on eighth, ninth and tenth individual average monthly yields than the early and mid-stages of lactation. The significant influence of season of calving on various individual monthly milk yields was observed by many workers (Shrivastava and Khan 1987, Kumar 1990, Gaur 1996, Pawar and Narayankhedkar 2002, Singh 2006, Raja 2010, Mundhe *et al.* 2015) in different breeds of cattle. However, Singh *et al.* (1988) and Qureshi *et al.* (1995) reported non-significant influence of season of calving on different part lactation milk yields in Sahiwal and Gir cattle, respectively. In general, the winter calvers produced comparatively higher average milk production than the summer and rainy calvers in the early stages of lactation (first three months of lactation) while the rainy calvers produced higher monthly yields during their mid stages of lactation (fourth to seventh month) and summer calvers produced the highest milk yields during their later stages of lactation i.e. significant effect of AFC on second to sixth individual monthly yields in Sahiwal cattle. The significant influence of AFC on different monthly yields was also reported by Varshney and Tomar (1982), Shrivastava and Khan (1987), Kumar (1990), Qureshi *et al.* (1995), Gaur (1996), Singh (2006) and Raja (2010). However, Roy *et al.* (2001) reported non-significant regression of monthly milk yields on AFC in HF cattle. Based on this result, it may be inferred that optimum age at first calving should be maintained to attain higher monthly milk production during the first seven months of lactation as this period covers nearly 80% of the lactational yield. Based on the results, it was concluded that the winter months are the most suitable season for the Frieswal cows to produce more milk and the age at first calving should be maintained at optimum so as to increase the milk production performance of Frieswal cows.

SUMMARY

In the present study, the individual monthly milk yields of 442 Frieswal cows sired by 30 bulls at Military Dairy Farm, Meerut over a period of 8 years (2006–2013) were analyzed to study the effect of various factors. The effect of sire was not significant on any of the monthly yields while the season of calving had significant effect on average milk yields at eighth, ninth and tenth months of lactation. The period of calving had significant effect only on ninth

Table 2. Least squares means for various individual monthly milk yields (kg) in Frieswal cattle

Month	Overall		Season						Period							
			Winter		Summer		Rainy		2006-07		2008-09		2010-11		2012-13	
	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE
One	440	313.915± 6.997	199	320.669± 8.649	151	314.940± 10.126	60	306.137± 11.614	83	269.691± 20.709	76	295.376± 16.580	150	342.208± 15.083	131	348.386± 21.227
Two	441	347.532± 7.879	199	361.298± 9.739	151	341.999± 11.399	91	339.300± 13.017	83	311.369± 23.310	76	337.331± 18.646	151	359.281± 16.937	131	382.148± 23.869
Three	441	337.364± 7.674	199	342.065± 9.486	151	330.400± 11.103	91	339.626± 12.680	83	308.093± 22.706	76	326.118± 18.163	151	338.161± 16.497	131	377.083± 23.250
Four	442	323.323± 8.213	199	319.856± 10.151	152	318.686± 11.866	91	331.427± 13.570	83	300.667± 24.297	76	310.834± 19.436	152	322.011± 17.653	131	359.781± 24.886
Five	442	305.497± 7.107	199	299.484± 8.784	152	299.045± 10.269	91	317.962± 11.743	83	293.983	76	300.079	152	302.434	131	325.491
Six	440	288.258± 7.124	197	283.827± 8.821	152	281.636± 10.296	91	299.310± 11.768	83	280.376± 21.076	75	291.336± 16.862	152	278.560± 15.312	130	302.758± 21.593
Seven	430	269.470± 6.652	194	257.041± 8.167	148	272.611± 9.584	88	278.759± 11.082	81	238.988± 19.531	75	273.522± 15.671	148	264.210± 14.276	126	301.160± 20.318
Eight	418	236.345± 7.376	191	221.965^{a}± 9.104	142	254.686^{b}± 10.544	85	232.384^{ab}± 12.263	77	206.866± 21.717	74	256.355± 17.530	144	236.598± 15.600	123	245.560± 22.843
Nine	348	229.842± 8.324	160	214.112^{a}± 10.006	121	251.289^{b}± 11.267	67	224.125^{ab}± 13.881	62	160.556^{a}± 23.214	67	246.806^{ab}± 18.232	125	235.586^{ab}± 16.876	94	276.419^{b}± 24.332
Ten	284	158.226^{a}± 8.097	130	140.779^{a}± 9.844	107	171.045^{b}± 10.516	47	162.853^{ab}± 13.954	47	134.534± 22.356	60	155.747± 17.195	106	169.363± 15.714	71	173.259± 22.355

Means bearing different superscripts in a group differ significantly.

month of lactation while the age at first calving had highly significant effect on yield up to first seven months of lactation. Based on the results, it was concluded that the winter months are the most suitable season for the Frieswal cows to produce more milk and the age at first calving should be maintained at optimum so as to increase the milk production performance of Frieswal cows.

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