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Non-genetic factors affecting first lactation reproduction traits of frieswal heifers/ cows under field conditions

S.K. MINJ[1], D.V. SINGH[2*], C.B. SINGH[3], SHIV PRASAD[4], SANJAY KUMAR[5] and ANIL KUMAR[6]

Deptt. of Livestock Production Management,
College of Veterinary and Animal Sciences,
G.B. Pant University of Agric. & Tech., Pantnagar – 263 145, India

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ABSTRACT

Frieswal (HF x Sahiwal) are the important crossbred cattle population in India for milk production. An investigation was carried out with farmers of U.S. Nagar district of Uttarakhand on Frieswal heifers/ cows during Nov. 2010 to Feb. 2016 to study the effect of various non-genetic factors (blocks, herd size, land holding, education level of farmers, caretakers of herd, marketable milk surplus, season/ year of birth/ calving) on age at first service, age at first conception, no. of services required for first conception, age at first calving, first service period and first calving interval using least-squares analysis of variance. The overall least-squares means for these traits were 840.7±57.9 days, 906.6±64.9 days, 1.75±0.29, 1103.2±80.6 days, 142.1±4.2 days and 520.1±47.4 days based on 569, 539, 538, 337, 163 and 88 observations, respectively. These traits were significantly affected by varying non-genetic factors. Information on this aspect is useful in implementing any large scale field based animal breeding program with respect to crossbred cattle in general and Frieswal cattle in particular.

Key words: First lactation, Frieswal cattle, Reproduction traits

Crossbred cattle contribute significantly to India's milk output. These cattle are reared under different management regimen throughout the country. Frieswal (HF x Sahiwal) is an important crossbred cattle population of the country. As milk production is followed by reproduction, optimum range of reproduction traits is pre-requisite to profitable milk production. Therefore, the study of various non-genetic factors affecting the reproduction traits is essential. Information on this aspect with respect to various first lactation reproduction traits of Frieswal crossbred heifers/ cows is scanty under field conditions. Present study is, therefore, undertaken to explore more on this aspect, particularly in the area where a systematic field recording program is already going on.

1 MVSc. Scholar (LPM), College of Veterinary and Animal Sciences, G.B. Pant University of Agric. & Tech., Pantnagar

2* Corresponding Author: Prof. & Head (LPM), College of Veterinary and Animal Sciences, G.B. Pant University of Agric. & Tech., Pantnagar. E-mail: singhdvs56@gmail.com

3,4,5 Professor (LPM), College of Veterinary and Animal Sciences, G.B. Pant University of Agric. & Tech., Pantnagar

6 Assistant Professor (LPM), College of Veterinary and Animal Sciences, G.B. Pant University of Agric. & Tech., Pantnagar

MATERIALS AND METHODS

Present investigation was carried out with farmers of U.S.Nagar district of Uttarakhand who reared Frieswal heifers/ cows under All India Co-ordinated Research Project (AICRP)– Frieswal Progeny Testing Unit during Nov. 2010 to Feb. 2016. The farmers covered under 5 blocks (Pantnagar, Gadarpur, Bazpur, Bara, Sitarganj) of U.S.Nagar district were approached to collect the information related to varying pattern of their herd size (in adult animal equivalent, AUE), land holding (landless, small, medium, large), education level (Illiterate, matriculate, above matriculate), caretakers of herd (male head, lady head, both heads, hired person) and marketable milk surplus (not sold, sold up to 50% and sold more than 50%) as well as season of birth/ calving. Data related to age at first service (AFS, in days), age at first conception (AFC, in

days), no. of services required for first conception (AIN, no.), age at first calving (AC, in days), first service period (FSP, in days) and first calving interval (FCI, in days) were derived out from bureau of records of AICRP and subjected to least-squares analysis of variance to find out the factors affecting these traits[10]. Following model was employed for data analysis:

$$Y_{ijklmnop} = \mu + B_i + S_j + Y_k + H_l + L_m + E_n + C_o + M_p + e_{ijklmnop}$$

Where,

$Y_{ijklmnop}$	is reproductive trait of animal
μ	is the population mean
B_i	is the effect of ith block
S_j	is the effect of jth season of birth
Y_k	is the effect of kth year of birth
H_l	is the effect of lth herd size
L_m	is the effect of mth land holding
E_n	is the effect of nth education level
C_o	is the effect of oth care taker
M_p	is the effect of pth marketable surplus
$e_{ijklmnop}$	is the random error, N $(0, \sigma_e^2)$

RESULTS AND DISCUSSION

Age at first service (AFS)

The overall least-squares mean for AFS of 569 Frieswal heifers was 840.7±57.9 days with CV 25.3% (Table 1). The present value is in agreement in crossbred dairy cows (890.6±195.2 days)[6], lower to Vrindavani (696.9±7.4 days)[26] and Frieswal crossbred cattle (608.3±27.1; 626.2±13.4 days)[3,27] and higher to local×Sahiwal and local×HF heifers (1517.4±53.1 and 1201.7±68.3 days)[9] in Bangladesh.

Trait was significantly affected by blocks (P<0.01), year of birth (P<0.01) and education level (P<0.05) of farmers. Among all blocks, AFS ranged from 781.65±65.66 to 891.94±60.80 days, being significantly (P<0.01) lower in Pantnagar block and highest in Bara block. This variation reflected varying skills of A.I.Workers as well as pattern of care and management of the livestock by farmers of different blocks. AFS was significantly lower for the year 2014 (650.91±69.23 days) and highest for the year 2011 (942.34±57.08 days). This may be attributed to the improved management practices of farmers which they might have adopted over time. The value was significantly lower (802.13±57.39 days) with farmers having matriculate education level and was maximum (872.30±64.43 days) with illiterate farmers, signifying that education level of farmers is an important consideration for animal husbandry practices. Significant effect of blocks[3] and year of birth[3] and year and season of birth have been reported[1,14]. The effect of other non-genetic factors (season of birth, herd size, land holding, caretaker of herd and marketable milk surplus) was not found to be significant on the trait in the present study. This was in consonance with other workers[3,14,21].

The productivity of dairy cattle depends mainly on their reproductive performance and efficiency of service per conception[5]. Reproductive performance is an important characteristic of outstanding importance in dairy farming and is the basis of profitable production[6,18].

Age at first conception (AFC)

The overall least-squares mean for age at first conception (AFC) of 538 Frieswal heifers was 906.6±64.9 days with CV 25.5% (Table 1). The present value was lower in HF × Sahiwal heifers (679.5±8.03 days)[22], in Vrindavani crossbred cattle (746.28±8.94 days)[26] and in Frieswal heifers (610.2±25.2 days)[3], based on lesser observations.

The trait was significantly affected by blocks, season of birth, year of birth, education level of farmers and marketable milk surplus. Among all blocks, AFC was significantly lower in Pantnagar (835.30±73.57 days) and highest in Bara (983.50±68.20 days) block. The trait was lowest for heifers born in winter season (854.18±65.07 days) and in the year 2014 (671.85±86.09 days) and highest for spring season (934.93±69.27 days) and in the year 2010 (1026.81±71.74 days). Its value was significantly lower (864.72±64.30 days) with farmers having matriculate education level and those famers who sold the milk up to 50% (764.70±65.91 days) and was maximum (943.07±72.05 days) with illiterate ones and with those who consumed the produce completely (1159.94±165.61 days), indicating

positive role of education as well as milk market business in profitable animal husbandry. The effects of other non-genetic factors (herd size, land holding and caretaker of herd) were non-significant on AFC. Significant effect of AI centers[3] and year of birth[16,17,22] and non-significant effect of herd size, land holding[3] and caretaker of herd[3], season of birth[4,16] have been reported in HF crossbred heifers.

Table 1. Least-squares means and their SE for age at first service (AFS), age at first conception (AFC) and No. of AI required for first conception (AIN) in Frieswal crossbred heifers

Effects	Particulars	AFS (days)	AFC (days)	AIN (no.)
Blocks	Pantnagar	$781.7^{B} \pm 65.7$ (74)	$835.3^{B} \pm 73.6$ (69)	$1.63^{AB} \pm 0.33$ (69)
	Gadarpur	$815.8^{AB} \pm 58.4$ (165)	$856.4^{B} \pm 65.6$(157)	$1.56^{B} \pm 0.29$ (157)
	Bazpur	$883.8^{A} \pm 61.2$ (130)	$934.9^{AB} \pm 68.4$(122)	$1.60^{AB} \pm 0.30$ (122)
	Bara	$891.9^{A} \pm 60.8$ (82)	$983.5^{A} \pm 68.2$ (72)	$1.99^{A} \pm 0.30$ (72)
	Sitarganj	$830.4^{AB} \pm 60.0$ (118)	$923.1^{AB} \pm 67.0$ (118)	$1.96^{A} \pm 0.30$ (118)
Season of birth	Spring	851.4 ± 61.8 (115)	$934.9^{a} \pm 69.3$(111)	1.79 ± 0.31 (110)
	Summer	853.6 ± 58.6 (167)	$917.4^{ab} \pm 65.5$(160)	1.76 ± 0.29 (160)
	Rainy	850.9 ± 61.6 (79)	$920.0^{ab} \pm 69.0$ (76)	1.85 ± 0.31 (77)
	Winter	806.9 ± 58.1 (208)	$854.2^{b} \pm 65.1$(191)	1.59 ± 0.29 (191)
Year of birth	2010	$923.5^{A} \pm 64.6$ (55)	$1026.8^{A} \pm 71.7$(55)	1.87 ± 0.32 (55)
	2011	$942.3^{A} \pm 57.1$ (155)	$1019.6^{A} \pm 63.5$(155)	1.73 ± 0.28 (156)
	2012	$894.9^{A} \pm 58.9$ (221)	$973.8^{A} \pm 65.7$(219)	1.78 ± 0.29 (219)
	2013	$791.9^{B} \pm 60.3$ (113)	$841.1^{B} \pm 67.2$(96)	1.76 ± 0.30 (96)
	2014	$650.9^{C} \pm 69.2$ (25)	$671.9^{B} \pm 86.1$(13)	1.60 ± 0.39 (12)
Herd size	< 3 AUE	881.3 ± 55.3 (119)	949.2 ± 61.7 (107)	1.72 ± 0.27 (107)
	>3 to 6 AUE	826.8 ± 68.7 (256)	904.7 ± 77.8 (245)	1.88 ± 0.35 (244)
	>6 to 10 AUE	822.3 ± 69.6 (132)	884.6 ± 78.7 (129)	1.80 ± 0.35 (130)
	>10 AUE	832.5 ± 72.8 (62)	888.1 ± 82.6 (57)	1.60 ± 0.37 (57)
Land holding	Landless	821.9 ± 59.1 (105)	873.8 ± 66.2 (98)	1.59 ± 0.29 (98)
	Small	836.2 ± 59.5 (288)	907.4 ± 66.6 (270)	1.79 ± 0.30 (269)
	Medium	847.7 ± 61.7 (108)	922.3 ± 69.1 (104)	1.81 ± 0.31 (105)
	Large	857.0 ± 64.4 (68)	923.1 ± 71.9 (66)	1.80 ± 0.32 (66)
Education level	Illiterate	$872.3^{a} \pm 64.4$ (42)	$943.1^{a} \pm 72.1$ (40)	1.73 ± 0.32 (40)
	Matriculate	$802.1^{b} \pm 57.4$ (377)	$864.7^{b} \pm 64.3$ (353)	1.76 ± 0.29 (353)
	> Matriculate	$847.7^{a} \pm 59.2$ (150)	$912.1^{a} \pm 66.3$(145)	1.76 ± 0.29 (145)
Care taker	Male head	857.6 ± 60.2 (145)	923.7 ± 67.4 (137)	1.70 ± 0.30 (136)
	Lady head	842.8 ± 63.3 (92)	929.2 ± 70.8 (91)	1.86 ± 0.31 (91)
	Both heads	857.4 ± 58.5 (238)	918.1 ± 65.5 (220)	1.79 ± 0.29 (221)
	Hired person	805.0 ± 60.2 (94)	855.6 ± 67.4 (90)	1.65 ± 0.30 (90)

Marketable Surplus	Not sold	1051.4 ± 150.5 (3)	1159.9[a] ± 165.6 (3)	1.92 ± 0.73 (3)
	Up to 50%	722.7 ± 56.5 (110)	764.7[b] ± 65.9 (99)	1.80 ± 0.29 (99)
	> 50 %	748.1 ± 23.9 (456)	795.3[ab]± 28.4 (436)	1.53 ± 0.13 (436)
Overall		840.7 ± 57.9 (569)	906.6 ± 64.9 (538)	1.75 ±0.29 (538)
CV (%)		25.3	25.5	56.9

Least-squares means followed by same or no upper case letters as superscripts in the column do not differ significantly (a, b; P<0.05), (A, B, C; P<0.01).

AFC is the period from birth of animal to the insemination date that is making her conceive first time in life. At this age heifer could reach reproductive maturity, enabling her to carry fetus to full term. AFC has for long been the centre of attention of dairy experts with regard to the possibility for shortening of the generation interval[20]. For the purpose of reduction of recurring cost it is preferable that rearing period to first conception is reduced optimally.

No. of AI required for first conception (AIN)

The overall least-squares mean for AIN of 538 Frieswal crossbred heifers was 1.75±0.29 with coefficient of variation 56.9% (Table 1). Present value was reported higher[3,12,23] as well as lower [21,24] in crossbred cattle.

The trait was significantly (P<0.01) affected by blocks and it was lowest in Gadarpur (1.557±0.291) and highest in Bara (1.996±0.302) block, signifying role of farmers as well as AIW of the area. The effect of other non-genetic factors (season of birth, year of birth, herd size, land holding, education level of farmers, caretaker of herd and marketable milk surplus) was non-significant. This was in consonance in crossbred cattle[3]. However, significant effect of year of service and non-significant effect of season of service in crossbred and local dairy cows have been reported[21].

The minimum number of service per conception is the important indicator of economically profitable dairy farming. AIN may be influenced by many factors like quality and quantity of semen, improper detection of heat, failure to inseminate at appropriate time as well as skill of inseminator. The other related factors are the level of fertility of cows and bulls, which may be influenced by diseases, semen handling techniques and other environment factors[14].

Age at first calving (AC)

The overall least-squares mean for age at first calving (AC) of 337 Frieswal crossbred heifers was 1103.2±80.6 days with coefficient of variation 17.8% (Table 2). Its value was lower in HF crossbreds[3,8,13,15,17,19,26,27,29] and higher in different crosses of HF cattle[2,11,24,28].

The trait was significantly affected by blocks, year of birth and education level of farmers (Table 2) and was significantly lower in Pantnagar block (1031.12±90.03 days) and highest in Sitarganj and Bara (1145.92±82.00 days) blocks. It was lowest for those who took birth during the year 2013 (938.19±88.54 days) and with farmers having matriculate education level of education (1055.44±79.62 days) and highest for those who were born during the year 2010 (1194.81±87.54 days) and with illiterate farmers (1154.57±88.96 days), indicating positive role of education in animal husbandry. Significant effect of period[2,17,28] and of farm[28] on AC was reported in HF crossbreds. Other non-genetic factors (season of birth, herd size, land holding, caretaker of herd and marketable milk surplus) did not affect the trait significantly. Such effect of season was in consonance in HF crosses[11,17,28].

Age at first calving is one of the most important reproduction traits that decide economics of dairy husbandry. Hence, dairy farmers are always interested to optimally reduce it to increase production life of (no. of lactations) of the cow[25].

First service period (FSP)

The overall least-squares mean for first service period (FSP) based on 163 observations on Frieswal crossbred cows was 142.1±4.2 days with coefficient of variation 37.5% (Table 2). The present value

is in agreement[13,30] and lower in HF crossbred cows[2,17,24,26].

The trait was significantly (P<0.05) affected by season of calving and year of calving. It was significantly lower for rainy season calvers (135.97±9.75 days) and those calved during the year 2013 (136.86±7.28 days) and highest for spring season calvers (145.40±10.10 days) and those who were calved during the year 2014 (146.19±6.33 days). Significant effect of season of calving[17,30] and of period of calving[2,13,30] have been reported in HF crossbred cows at different farms.

Table 2. Least-squares means and their SE for age at first calving (AC) and first service period (FSP) and first calving interval (FCI) in Frieswal crossbred cows

Effects	Particulars	AC (days)	FSP (days)	FCI (days)
Blocks	Pantnagar	1031.1^{c} ± 90.0 (37)	119.9 ± 10.3 (14)	476.3 ± 76.9 (4)
	Gadarpur	1064.0^{bc}± 81.7 (112)	137.7 ± 6.0 (56)	558.3 ± 51.4 (34)
	Bazpur	1131.3^{a} ± 84.6 (80)	140.8 ± 8.5 (37)	545.7 ± 58.5 (17)
	Bara	1143.8^{ab} ± 87.0 (28)	164.4 ± 16.7 (14)	543.8 ± 60.3 (7)
	Sitarganj	1145.9^{a} ± 82.0 (80)	148.8 ± 10.2 (42)	476.4 ± 48.7 (26)
Season of birth/ calving	Spring	1104.9 ± 85.2 (68)	145.4^{a} ± 10.1 (30)	506.1^{ab}± 57.0 (10)
	Summer	1115.8 ± 82.3 (99)	142.1^{a} ± 6.8 (52)	473.4^{b} ± 49.5 (25)
	Rainy	1121.8 ± 85.0 (43)	136.0^{b} ± 9.8 (32)	537.6^{ab}± 57.7 (23)
	Winter	1070.3 ± 80.2 (127)	144.0^{a} ± 8.3 (49)	563.4^{a} ± 45.0 (30)
Year of birth/ calving	2010	1194.8^{A} ± 87.5 (48)	-	-
	2011	1184.0^{A}± 78.6 (127)	-	-
	2012	1095.9^{B} ± 81.7 (136)	-	-
	2013	938.2^{C} ± 88.5 (26)	136.9^{a} ± 7.3 (50)	-
	2014	-	146.2^{b} ± 6.3 (83)	422.8^{B} ± 44.9 (23)
	2015	-	139.3^{a} ± 8.2 (30)	468.9^{B} ± 42.3 (62)
	2016	-	-	668.6^{A} ± 79.7 (3)
Herd size	< 3 AUE	1179.0 ± 76.7 (64)	146.5 ± 2.2 (25)	510.3 ± 62.5 (16)
	>3 to 6 AUE	1092.3 ± 95.6 (156)	145.1 ± 5.6 (72)	523.0 ± 68.3 (35)
	>6 to 10 AUE	1070.6 ± 97.1 (80)	134.1 ± 8.6 (44)	523.7 ± 70.3 (25)
	>10 AUE	1071.1 ± 101.3 (37)	142.9 ± 14.8(22)	523.5 ± 73.6 (12)
Land holding	Landless	1079.2 ± 82.4 (69)	135.1 ± 7.4 (36)	554.0 ± 52.6 (17)
	Small	1104.2 ± 82.2 (168)	145.6 ± 5.3 (85)	535.7 ± 46.0 (51)
	Medium	1104.0 ± 84.8 (60)	138.2 ± 13.0(26)	448.1 ± 53.9 (10)
	Large	1125.4 ± 88.4 (40)	145.2 ± 18.6(16)	542.7 ± 68.3 (10)
Education level	Illiterate	1154.6^{a}± 89.0 (24)	167.3 ± 24.0 (8)	571.1 ± 77.2 (3)
	Matriculate	1055.4^{b}± 79.6 (226)	141.5 ± 4.6(115)	513.1 ± 44.1 (62)
	> Matriculate	1099.7^{ab}± 82.1 (87)	138.6 ± 9.9 (40)	476.1 ± 44.6 (23)

Care taker	Male head	1109.2 ± 83.2 (88)	145.7 ± 8.7 (42)	504.1 ± 54.4 (21)
	Lady head	1116.7 ± 88.6 (58)	140.1 ± 8.0 (30)	515.0 ± 55.6 (19)
	Both heads	1136.0 ± 80.0 (143)	138.6 ± 6.5 (71)	499.1 ± 48.8 (35)
	Hired person	1050.9 ± 82.9 (48)	149.7 ± 13.5(20)	562.2 ± 53.4 (13)
Marketable surplus	Not sold	1247.6 ± 208.4 (3)	-	-
	Up to 50%	995.5 ± 79.3 (60)	146.5 ± 10.6 (25)	517.5 ± 94.3 (15)
	> 50 %	1066.6 ± 31.9 (274)	141.3 ± 4.6 (138)	522.7 ± 43.4 (73)
Overall		1103.2 ± 80.6 (337)	142.1 ± 4.2 (163)	520.1 ± 47.4 (88)
CV (%)		17.8	37.5	20.6

Least-squares means followed by same or no upper case letters as superscripts in the column do not differ significantly (a, b; P<0.05), (A, B, C; P<0.01).

The effect of other non-genetic factors (blocks, herd size, land holding, education level of farmers, care taker of the herd, marketable milk surplus and sex of calf) was not observed to be significant on the trait. This signifies that the trait, by and large, remained unaffected by these factors, which may be due to small number of observations in the present study. FSP is the important constituent of firs calving interval (FCI). Hence, optimization of FCI can only be done by due consideration to FSP.

First calving interval (FCI)

The overall least-squares mean for first calving interval (FCI) of Frieswal crossbred cows based on 88 observations was 520.1±47.4 days with coefficient of variation 20.6% (Table 2). Present value was marginally higher[2,11,13,24,26,27,30] and lower[12] as reported by various workers in HF crossbred cows.

The trait was significantly affected by season of calving and year of calving. Its value was lower for summer calvers (473.43±49.48 days) for the cows calved during 2014 (422.77±44.91 days) and highest for winter calvers (563.35±45.02 days) and for the year 2016 (668.62±79.73 days). Non-significant effect of season of calving[2,7,13,30] in HF crossbred cows and significant[30] as well as non-significant[3,13] effect of period of calving have been reported. The effect of other non-genetic factors (Blocks, herd size, land holding, education level of farmers, caretaker of herd and marketable milk surplus) was not found to be significant on FCI in the present investigation.

Similar to AFC, calving interval is also very important trait affecting economics of the dairy farm. Workers have been trying to optimise this trait also primarily by stressing upon optimising the service period[25].

CONCLUSION

Frieswal (HF x Sahiwal) are the important crossbred cattle contributing significantly to country's milk output. Present investigation was carried out with farmers of U.S.Nagar district of Uttarakhand on Frieswal heifers/ cows during Nov. 2010 to Feb. 2016 to understand effect of various non-genetic factors on age at first service (AFS), age at first conception (AFC), no. of services required for first conception (AIN), age at first calving (AC), first service period (FSP) and first calving interval (FCI). The overall least-squares means for AFS, AFC, AIN, AC, FSP and FCI was 840.7±57.9 days, 906.6±64.9 days, 1.75±0.29, 1103.2±80.6 days, 142.1±4.2 days and 520.1±47.4 days, respectively. These traits were significantly affected by varying non-genetic factors, viz. AFS by blocks, year of birth and education level of farmers; AFC by blocks, season of birth, year of birth, education level of farmers and marketable milk surplus; AIN by blocks; AC by blocks, year of birth and education level of farmers; FSP by season of calving and year of calving and FCI by season of calving and year of calving.

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