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Replacement rate and its components in Sahiwal females from birth to age at first calving

VIPIN KUMAR UPADHYAY[1], R K MEHLA[2], A K GUPTA[3], M BHAKAT[4], S S LATHWAL[5] and S K YADAV[6]

ICAR-National Dairy Research Institute, Karnal, Haryana 132 001 India

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ABSTRACT

The present study was conducted on 1,885 calving in 416 Sahiwal cows over a period of 20 years from 1994 to 2013 maintained at Livestock Research Centre, ICAR-NDRI, Karnal. The 20 years data were classified into 4 periods i.e. P1, P2, P3 and P4, each comprising of 5 years. The year of birth/calving was divided into 4 seasons, according to climatic condition of the farm as Winter, Summer, Rainy and Autumn. The parities were classified into 6 groups (first to fifth and sixth and above) and birth weight of calves was divided into 4 groups (≤18, 19 to 21, 22 to 24 and ≥25 kg). The percentage of animals disposed off due to mortality and culling was calculated as proportion by descriptive statistics and influence of various non-genetic factors by Chi-square method using SPSS software. The overall incidence of abnormal birth in Sahiwal was 6.21% and season of birth showed significant effect on abnormal birth which was higher in autumn season (12.37%) and lower in summer season (4.28%). The overall incidence of disposal, mortality and culling was 27.35, 23.63 and 3.72% respectively, while replacement rate on female calves and total calves basis were 72.64 and 37.55% respectively. There was significant effect of period of birth and birth weight of calf on the disposal, mortality and replacement rate. The maximum mortality was observed mainly due to pneumonia and enteritis, while poor growth and debility were the principal cause of culling. It is concluded that there was significant effect of period of birth and birth weight of calves on mortality, disposal and replacement rate. Disposal rate was higher in calves born with lower birth weight; therefore, intensive feeding and healthcare management for calves born with lower birth weight will be important to minimize involuntary disposal and facilitate more number of females calves to reach to milch herd.

Key words: Abnormal birth, Culling, Mortality, Replacement rate, Sahiwal

One of the major concerns of the dairy farm is to reduce involuntary culling and mortality, as it limits the genetic progress by providing fewer replacements. As the disposal (mortality and culling) is routine phenomenon of a dairy farm, so the knowledge of disposal plays an important role to decide the replacement rate of the farm to maintain proper herd structure. Survival of neonatal calves is imperative for livestock propagation. However, a large number of calves die during the first year of their life causing heavy drain on the economics of livestock production. Primary requirement for genetic improvement of the breed is of larger herd size (Singh *et al.* 2002) as larger herd facilitates in more intense selection and gives freedom for voluntary culling to the breeder. Disposal of animals is major problem in achieving the genetic improvement and large herd size. Therefore, getting more number of female calves by increasing the fertility status and reducing the involuntary disposal at prenatal as well as postnatal stages are the best ways to increase herd size for genetic improvement and profitable dairy enterprise. Therefore, identification of the factors that are responsible for excessive mortality and involuntary disposal of calves and heifers is an important prerequisite to avoid genetic and economical losses. Keeping in view all the above facts, objective of the present study was to observe the effect of non-genetic factors on replacement rate and its components in Sahiwal females from birth to age at first calving.

Present address: [1]PhD Scholar (vipinupadhyay4@gmail.com), [2,5]Principal Scientist (mehla@ndri.res.in, lathwal@gmail.com), [4]Senior Scientist (bhakat.mukesh@gmail.com), [6]M.V.Sc. Schoalar (vetsatendra@gmail.com), Livestock Production Management Section. [3]Principal Scientist (guptaak2009 @gmail.com), Animal Genetics and Breeding Division.

MATERIALS AND METHODS

The present study was conducted on Sahiwal cows and their calves belonging to Livestock Research Centre, ICAR-NDRI, Karnal, which comprised of 416 cows and 1,885 calving in Sahiwal herd over the period of 20 years from 1994 to 2013. The 20 years data were classified into 4 periods i.e. P1, P2, P3 and P4, each comprising of 5 years. The year of birth/calving was divided into 4 seasons, according to climatic condition of the farm as Winter (December to March), Summer (April to June), Rainy (July to September) and Autumn (October to November). The parities were classified in 6 groups (first to fifth and sixth

and above) and birth weight of calves divided into 4 groups (≤18; 19 to 21; 22 to 24 and ≥25 kg). The data were used to calculate various components of disposal pattern and replacement rate. Various components of disposal pattern were abnormal birth, mortality and culling rate in female calves and heifers up to age at first calving (AFC) and replacement rate for female calves. The average values of abnormal birth or prenatal calf losses were considered in terms of abortion, still birth and premature births.

Descriptive statistics were computed for analysis of disposal pattern and replacement rate. The percentages of animals disposed from the herd due to mortality and culling was calculated by proportion. The analysis of influence of various factors on disposal pattern and replacement rate was carried out by Chi-square method (Snedecor and Cochren 1994) using the SPSS software.

$$\chi 2 = \Sigma[(O - E)^2/E]$$

where, O, observed frequencies; E, expected frequencies.

Expected frequencies were calculated as follows,

$$E_{ij} = (R_i.)(C._j)/GT$$

where, E_{ij}, expected frequency belonging to i^{th} row and j^{th} column; $R_i.$, i^{th} row total; $C._j$, j^{th} column total; GT, grand total.

RESULTS AND DISCUSSION

Abnormal birth: The overall incidence of abnormal birth in Sahiwal was 6.21% among the 1,885 calving (Table 1). Similar findings were reported by Upadhyay *et al.* (2014) and Singh *et al.* (2011) for Sahiwal cattle. Lower estimates than the present finding were reported by Shahi and Kumar (2006), Banik and Naskar (2006), Abbas (2005), Rawal and Tomar (1996) for Sahiwal, and Lathwal *et al.* (1993) for Red Sindhi while higher estimates were observed by Upadhyay *et al.* (2017) for Karan Fries; Goshu and Singh (2013) for HF cattle; Shahi and Kumar (2006) for J × SW cross and Atrey *et al.* (2005) for Frieswal. The differences in findings may be due to different breed, geographical location, management differences and duration of data.

There was no significant effect of period on abnormal birth and it ranged from 4.59% in second period to 7.69% in third period. Effect of season of birth showed the significant (P≤0.01) effect on abnormal birth which was higher in autumn season (12.37%) and lower in summer season (4.28%). In autumn season, higher incidence of prenatal mortality might be due to preceding hot and humid weather of rainy season which is more stressful during their last trimester of gestation. Similarly, Upadhyay *et al.* (2014) also reported that the autumn calvers were more prone to calving abnormalities in Sahiwal. In contrast to our findings, Thiruvenkadan and Devendran (2014) for Murrah buffalo and Abbas (2005) for Sahiwal reported that the effect of period of birth was significant (P≤0.01) on abnormal birth while season of birth had no significant effect. Pandey *et al.* (2012) reported that the incidence of abortion was significantly (P≤0.01) affected by season and period of calving in crossbred animal. Atrey *et al.* (2005) also observed that season, period of birth and parity of dam had significant effect on abnormal birth in Frieswal crossbred cattle.

Disposal, mortality, culling and replacement rate: The overall incidence of disposal, mortality and culling was 27.35, 23.63 and 3.72% respectively, while replacement rate on female calves and total calves basis were 72.64 and 37.55% respectively, upto age at first calving (Table 1). Almost similar findings of mortality upto AFC were reported by Upadhyay *et al.* (2014) and Abbas (2005) for Sahiwal while lower estimates were observed by Shahi and Kumar (2006), Tomar and Rawal (1994) for Sahiwal; Lathwal *et al.* (1993) for Red Sindhi and higher values were reported by Banik and Naskar (2006) for Sahiwal; Upadhyay *et al.* (2017) for Karan Fries; Hossain *et al.* (2014) for HF; Pandey *et al.* (2012) for cross-bred; Shahi and Kumar (2006) in J × SW cross and Atrey *et al.* (2005) in Frieswal.

There was significant effect (P≤0.01) of period of birth and birth weight of calf on the disposal, mortality and replacement rate of calves upto age at first calving. The effect of period might be due to changes in different management strategies and practices over the period as it was higher in first period (P1) and lower in third period (P3) for disposal and mortality, while replacement rate was higher during third period (P3). The calves with lower birth weight (≤18kg) were more vulnerable to disposal and mortality. There was no significant effect of season of birth and parity of dam on these parameters although maximum mortality (23.30%) and disposal (27.96%) were found in the calves which were born during rainy season. Similarly, Shahi and Kumar (2006) also observed that the effect of period on mortality was significant; while, season of birth had no effect. The significant effect of period on mortality was due to variation in disease occurrence, climatic fluctuation and managemental practices. Similarly, Goshu and Singh (2013) also reported that the effects of season on mortality rates in Holstein Friesian females from birth to age at first calving were found to be non-significant, while year differences were found to be highly significant (P ≤0.01). Similar findings were also reported by Upadhyay *et al.* (2017) for Karan Fries; Banik and Naskar (2006) and Abbas (2005) for Sahiwal as the period of birth was found highly significant (P≤0.01) while season of birth and parity had non-significant effect on mortality. Regarding replacement rate, Thiruvenkadan and Devendran (2014) also reported the significant effect of period of birth on replacement rate in Murrah buffalo. Mukherjee and Tomar (1997) also found that period of birth significantly (P≤0.05) affected the mortality and replacement rate, while season of birth had no significant effect. Upadhyay *et al.* (2017) also reported the significant effect of period of birth and birth weight of calf on replacement rate in Karan Fries.

Reasons of disposal

Reasons of mortality in Sahiwal female calves and heifers up to AFC: The various reasons of mortality in Sahiwal

Table 1. Incidence of abnormal birth, disposal, mortality, culling and replacement rate (%) in Sahiwal from birth to AFC

Parameter	Total calving	Abnormal births	Normal births	Normal females	Disposal	Mortality	Culling	RRFC	RRTC
Overall	1885	6.21(117)	1768	914	27.35 (250)	23.63 (216)	3.72 (34)	72.64	37.55
Periods of birth/calving									
1994-1998 (P1)	249	6.02 (15)	234	130	38.46 (50)	32.30 (42)	6.15 (8)	61.53	34.18
1999-2003 (P2)	414	4.59 (19)	395	236	27.96 (66)	23.30 (55)	4.66 (11)	72.03	43.03
2004-2008 (P3)	533	7.69 (41)	492	249	18.47 (46)	14.45 (36)	4.016 (10)	81.52	41.26
2009-2013 (P4)	689	6.1 (42)	647	299	29.43 (88)	27.75 (83)	1.67 (5)	70.56	32.61
Chi square (df)		3.91 (3)	-	-	18.64** (3)	19.87** (3)	6.29 (3)	18.64** (3)	15.82** (3)
Season of birth/calving									
Winter (S1)	824	6.31(52)	772	400	27.25 (109)	24.00 (96)	3.25 (13)	72.75	37.69
Summer (S2)	514	4.28 (22)	492	256	26.95 (69)	23.04 (59)	3.90 (10)	73.05	38.01
Rainy (S3)	353	5.38 (19)	334	168	31.54 (53)	27.38 (46)	4.16 (7)	68.45	34.43
Autumn (S4)	194	12.37 (24)	170	90	21.11 (19)	16.66 (15)	4.44 (4)	78.88	41.76
Chi square (df)		16.37** (3)	-	-	3.27 (3)	3.80 (3)	0.49 (3)	3.28 (3)	2.72 (3)
Parity of dam									
Parity 1	529	7.56 (40)	489	268	27.61 (74)	23.88 (64)	3.73 (10)	72.38	39.67
Parity 2	455	8.13 (37)	418	199	26.63 (53)	23.11 (46)	3.51 (7)	73.36	34.93
Parity 3	324	4.63 (15)	309	163	23.31 (38)	19.63 (32)	3.68 (6)	76.68	40.45
Parity 4	220	4.55 (10)	210	111	30.63 (34)	26.12 (29)	4.50 (5)	69.36	36.66
Parity 5	151	4.64 (7)	144	68	36.76 (25)	32.35 (22)	4.41 (3)	63.23	29.861
Parity ≥6	206	3.88 (8)	198	105	24.76 (26)	21.90 (23)	2.85 (3)	75.23	39.899
Chi square (d.f.)		9.54 (5)	-	-	5.38 (5)	4.90 (5)	0.52 (5)	5.39 (5)	7.44 (5)
Birth weight of calves									
≤18 kg	-	-	343	208	34.13 (71)	31.25 (65)	2.88 (6)	65.86	39.94
19-21 kg	-	-	773	442	23.30 (103)	19.68 (87)	3.62 (16)	76.69	43.85
22-24 kg	-	-	493	213	30.51 (65)	24.88 (53)	5.63 (12)	69.48	30.02
≥25 kg	-	-	159	51	21.56 (11)	21.56 (11)	0.00 (0)	78.43	25.15
Chi square (df)		-	-		10.39** (3)	16.30** (3)	2.34 (2)	10.40** (3)	41.94** (3)

Figures in parentheses are number of observations; *, significant at P≤0.05; **, significant at P≤0.01; df, degree of freedom; RRFC, replacement rate on female calf basis; RRTC, replacement rate on total calf basis; AFC, age at first calving

Table 2. Reasons of mortality in Sahiwal from birth to AFC

Reasons of mortality	Calf mortality (N)	% of total mortality	% of Female calf
Pneumonia	61	28.24	6.67
Enteritis and gastro-enteritis	51	23.61	5.58
Pneumo-enteritis	9	4.16	0.98
Liver disorder	2	0.92	0.21
Cardio -vascular problem	14	6.48	1.53
Toxaemia and Septicaemia	11	5.09	1.20
Debility and poor health	47	21.75	5.14
Parasitic infection	1	0.46	0.10
Tympany and digestive system problem	10	4.63	1.09
Miscellaneous	10	4.63	1.09
Overall	216	100.00	23.63

Table 3. Reasons of culling in Sahiwal from birth to AFC

Reasons of culling	Calf culled (N)	% of total culled	% of Female calf
Poor health and debility	24	70.59	2.63
Reproductive problem	5	14.71	0.55
Lameness and physical deformity	3	8.83	0.33
Miscellaneous	2	5.88	0.22
Overall	34	100.00	3.72

females' up to AFC are presented in Table 2. It was found that the maximum (28.24%) mortality in calves were due to the pneumonia which might be due to inclement weather in winter followed by enteritis and gastro-enteritis (23.61%) due to higher worm load in rainy season; debility and poor health (21.75%), cardio-vascular problem (6.48%), toxaemia and septicaemia (5.09%) and so on. The miscellaneous causes of mortality were joint ill, navel ill, dehydration, anoxia, poisoning, snake bite, encephalitis and hernia. Maximum mortality was observed mainly due to pneumonia and enteritis, which was in general agreement with findings of Singh and Gurnani (2004). This is probably because neonates are more susceptible to viral and bacterial infections.The present findings revealed that higher incidence of mortality was due to pneumonia and similar findings were also reported by Upadhyay (2013) and Reddy and Nagarcenkar (1989) for Sahiwal; and Maher *et al.* (2015) for Tharparkar. Panmei *et al.* (2016) reported that

the maximum mortality in Tharparkar calves was due to general debility followed by respiratory problem, enteritis and gastroenteritis.

Reasons of culling in Sahiwal female calves and heifers up to AFC: Various reasons of culling in female calves' up to AFC is presented in Table 3. It was observed that the maximum culling was due to poor health and debility (70.58%) followed by reproductive problems (14.70%), lameness and physical deformity (8.82%) and miscellaneous (5.88%). Miscellaneous causes were off bred, transfer and skin infection. The results indicated that poor growth and late maturity were the principal reasons of culling. The results obtained were in conformity with the findings of Singh and Gurnani (2003). Similar findings were also reported by Upadhyay *et al.* (2014) for Sahiwal and Jadhav *et al.* (1995) for Friesian Sahiwal cross.

The present study concluded that there was significant effect of period of birth and birth weight of calves on mortality, disposal and replacement rate. Disposal rate was higher in calves born with lower birth weight, therefore proper management practices during early life of calves born with lower birth weight will improve the herd health status and reduce the chances of mortality and involuntary culling of calves which facilitate the female calves and heifer to reach the milch herd.

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