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Non genetic factors influencing fertility problems in Murrah buffaloes

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ABSTRACT

The data on 2449 reproduction records of Murrah buffaloes were analysed using SAS to study the effect of various non genetic factors on the incidence of fertility problems (repeat breeding, true anoestrus and anoestrus due to persistent corpus luteum). The association between non-genetic factors and fertility problems were analysed using Chi squares method. To study the effect of these independent variables simultaneously, multiple logistic regression method was used. Overall fertility problems and true anoestrus were significantly ($p<0.01$) higher in buffaloes calved during winter and significantly ($p<0.01$) lower in those calved during rainy season of the year. However, the association between anoestrus PCL and season of calving was not significant. Significantly ($p<0.05$) higher incidence of repeat breeding was reported in autumn season and third period of study. The incidence of anoestrus was significantly ($p<0.01$) higher in heifers and first calvers in comparison to older buffaloes. Parity showed non-significant association with incidence of repeat breeding in Murrah buffaloes. Highly significant association ($p<0.01$) was observed between uterine health problems and incidence of all the fertility problems, which increased with the severity of post partum uterine health complications. Logistic regression results also revealed higher ODDS ratio for incidence of overall fertility problems in those suffered from uterine health problems only (3.35) and both calving abnormalities and uterine health problems (3.16) in comparison to normal (1.00) animals. Similarly, significantly ($p<0.01$) higher ODDS ratio were observed for incidence of anoestrus (3.12 and 2.92) and repeat breeding (6.43 and 5.05). From the present investigation it has been concluded that multiple logistic regression can be used effectively to study the effect of various non-genetic factors on discrete dependent variables like fertility problems in animals.

Key words: Fertility problems, Logistic regression, Murrah buffaloes, Non-genetic factors

Buffalo is considered as the major dairy animal and backbone of Indian dairy industry. To make dairying a successful and profitable business, the animals should not only be high producing, but also healthy with optimum reproductive performance. However, incidence of various fertility problems causes huge economic losses and reduced replacement rate. Repeat breeding and anoestrus are the substantial problems in dairy animal breeding leading to increased calving interval and culling rate and decreased profitability of farm. Various non-genetic factors are influencing the incidence of these fertility problems in buffaloes. Hence, an investigation was conducted to evaluate the influence of these factors on fertility problems in an organized herd of Murrah buffaloes maintained in the tropical climatic conditions.

MATERIALS AND METHODS

The present study used the data on 2,449 reproduction records of Murrah buffaloes maintained at National Dairy Research Institute, Karnal, Haryana (India) and spread over a period of 18 years (calved from 1993–2010). The data were analysed using SAS package (enterprise guide 5.1) to study the effect of parity, season of calving, period of calving and post-parturient uterine health status on incidence of various fertility problems. The fertility problems considered in the present investigation were true anoestrus, anoestrus due to persistent corpus luteum (PCL) and repeat breeding. The whole year was divided into 4 seasons, i.e. winter (Dec-Mar), summer (Apr-June), rainy (July-Sep) and autumn (Oct-Nov) on the basis of prevailing climatic conditions. The data spread over a period of 18 years were divided into 4 periods each of 4 to 5 years duration to examine the effect of possible changes in management practices over the

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periods. To study the effect of calving abnormalities (abortion, stillbirth and dystocia) and uterine health problems (retention of foetal membranes, metritis and pyometra) on fertility problems of buffaloes the data were classified into 4 groups– normal (not affected), affected with calving abnormalities only, uterine health problems only and both. The association between these non-genetic factors and fertility problems were analysed using Chi squares method (Snedecor and Cochran 1994).

$$X^2 = \sum (O-E)^2/E$$

where, O was the observed frequency and E was the expected frequency.

Logistic regression: It is very difficult to identify genetic and non-genetic factors influencing various functional traits in dairy animals using conventional analysis wherein the normality of residual error is assumed. Under such conditions of binary or discontinuous nature of response variable, logistic regression can facilitate effectively in exploring the relationship between the dependent and independent variables. Logistic regressions work with odds rather than proportions. The odds are simply the ratio of proportions for two possible mutually exclusive outcomes. If p is the proportion for one outcome, then (1–p) is the proportion for second mutually exclusive outcome;

$$\text{ODDS} = p / (1-p)$$

The logistic regression model relates the log of the odds to explanatory variable in the form of a linear function. In multiple logistic regression more than one continuous/ discrete explanatory variable can be incorporated in the model to study their simultaneous effect on the categorical response variable. In the present study Akaike Information Criterion (AIC) and Schwarz Criterion (SC) were used to assess the fitness of the model.

RESULTS AND DISCUSSION

The overall incidence of fertility problems in Murrah buffaloes was observed to be 40.22%, which includes anoestrus and repeat breeding. The animals affected with various fertility problems were not mutually exclusive being same animal affected with different fertility problems in a particular lactation. The overall anoestrus which includes both true anoestrus and anoestrus due to persistent corpus luteum (PCL) was 34.26%. Banerjee *et al.* (1992), Singh and Sahni (1995) and Sreemannarayana and Rao (1996) reported still higher incidence of anoestrus in buffaloes, whereas, others revealed lower incidence of anoestrus in buffaloes (Gautam and Kharche 1992, Kumar and Kumar 1993, Singla and Verma 1994, Selvaraju *et al.* 2005, Taraphder *et al.* 2007). The present study indicated that the incidence of repeat breeding in Murrah buffaloes was 11.56%. Taraphder *et al.* (2007) also reported similar incidence of repeat breeding in Murrah buffaloes. Sreemannarayana and Rao (1996), Selvaraju *et al.* (2005) and Kumar and Singh (2009) observed comparatively lower incidence of repeat breeding in buffaloes. On the other hand, Singla and Verma (1994) and Rahman *et al.* (1997) reported higher incidence of repeat breeding in Murrah buffaloes.

The incidence of fertility problems in relation to different non-genetic factors is presented in Table 1. The effects of

Table 1. Incidence of fertility problems in relation to different non-genetic factors

Effect	No. of calvings	Female fertility indicator traits			
		Overall fertility problems	True anoestrus	Anoestrus PCL	Repeat breeding
Overall	2449	40.22 (985)	21.11 (517)	22.46 (550)	11.56 (283)
Season					
Winter	668	46.86^a (313)	28.74^a (192)	24.70 (165)	10.63^a (71)
Summer	409	43.28^b (177)	21.27^b (87)	22.98 (94)	13.69^a (56)
Rainy	913	34.06^c (311)	15.55^c (142)	20.04 (183)	9.64^a (88)
Autumn	459	40.09^b (184)	20.92^b (96)	23.53 (108)	14.81^b (68)
Periods					
1993–1997	703	26.74^a (188)	13.80^a (97)	10.53^a (74)	12.38^a (87)
1998–2001	549	42.62^b (234)	14.39^a (79)	31.88^b (175)	10.38^a (57)
2002–2005	458	48.69^c (223)	34.28^b (157)	23.14^c (106)	15.07^a (69)
2006–2010	739	46.01^c (340)	24.90^c (184)	26.39^b (195)	9.47^b (70)
Parity					
1	786	49.87^a (392)	30.66^a (241)	28.50^a (224)	12.72 (100)
2	553	36.35^b (201)	17.90^b (99)	21.52^b (119)	11.39 (63)
3	389	39.59^b (154)	18.51^b (72)	22.11^b (86)	12.08 (47)
4	270	36.67^b (99)	16.67^b (45)	21.11^b (57)	10.37 (28)
5 and above	451	30.82^c (139)	13.30^c (60)	14.19^c (64)	9.98 (45)
AC-UTH					
Normal	1145	25.11^a (287)	13.30^a (152)	12.25^a (140)	4.02^a (46)
AC	44	20.45^a (9)	4.55^a (2)	4.55^a (2)	11.36^b (5)
UTH	1094	54.39^b (595)	28.70^b (314)	32.18^b (352)	18.65^c (204)
AC&UTH	166	56.63^b (94)	29.52^b (49)	33.73^b (56)	16.87^c (28)

Means with similar superscript do not differ significantly.

Table 2. Wald Chi-square values for fertility problems in Murrah buffaloes

Effect	df	Chi-square value			
		Overall fertility problems	True anoestrus	Anoestrus PCL	Repeat breeding
Overall	13	294.61**	226.72**	215.35**	131.22**
Season	3	24.47**	40.13**	3.86	7.84*
Period	3	29.47**	59.79**	61.69**	21.48**
Parity	4	59.16**	67.04**	42.98**	3.50
AC-UTH	3	174.74**	69.10**	106.17**	112.25**

*, Significant (P<0.05); **, significant (P<0.01).

season, period, parity and calving and uterine health status were significantly high on the incidence of overall fertility problems and anoestrus. However, the differences in season of calving not affected the incidence of anoestrus due to PCL. Calving and uterine health status and period of calving were significantly influencing the repeat breeding cases in buffaloes.

To study the simultaneous effect of various factors on the incidence of fertility problems, a multiple logistic regression model was fitted with season of calving, period of calving, parity and calving and uterine health status as independent variables. The Wald chi-square value for the overall model and various effects considered are presented in Table 2. The fitted model was found to be highly significant for overall incidence of fertility problems. The Wald chi-square analysis revealed that the influences of season, period, parity and calving and uterine health status were highly significant on the incidence of fertility problems in Murrah buffaloes.

The incidence of overall fertility problems was significantly different among animals calved during different seasons. The highest fertility problems were noticed in animals calved during winter (46.86%) followed by summer (43.28%) and autumn (40.09%) (Table 1). Animals calving during rainy season were found least affected (34.06%) with various fertility problems. The multiple logistic regression (Table 4) also revealed higher ODDS ratio in favour of fertility problems in buffaloes calved during winter (1.36) and summer (1.27) in comparison to those calved during rainy season (0.81).

The results showed an increasing trend in overall fertility problems over the periods. Similarly, the variation in incidence of fertility problems in different parities revealed a gradual decline from first to five and above parity, except from second to third parity. The incidence of overall fertility problems was significantly higher in first calvers in comparison to later parities.

The incidence of fertility problems was significantly higher in those animals affected with uterine health problems alone or both calving abnormalities and uterine health problems. The ODDS ratio in favour of developing fertility problems was 3.35 and 3.16 for these 2 classes of animals in comparison to animals with normal calving and uterine health status (1.00).

The season of calving, period of calving, parity and calving and uterine health status were highly significantly affecting the incidence of anoestrus in Murrah buffaloes. The incidence of anoestrus was highest among animals calved during winter (41.17%) in comparison to those calved during rainy season (28.70). Gautam and Kharche (1992), Singla and Verma (1994) and Taraphder *et al.* (2007) also reported significant variation of anoestrus cases in different seasons of calving. Among the 2 types of anoestrus considered in the study, incidence of true anoestrus was varying highly significantly in different seasons of calving. However, the incidence of anoestrus due to PCL was not differing significantly among animals calved during different seasons of the year. The highest and lowest incidences of true anoestrus were reported during winter (28.74%) and rainy calvers (15.55%), respectively.

The incidence of overall anoestrus showed an increasing trend over the periods. Similarly both types of anoestrus were observed to be highest during later periods in comparison to earlier periods. Our results revealed that parity had highly significant effect on the incidence of anoestrus, which decreased with the increase in parity order. The highest incidence of both types of anoestrus and overall anoestrus were observed in first calvers and lowest in 5 and above parities. The negative energy balance due to simultaneous growth and milk production might be attributed to the higher incidence of anoestrous in primiparous buffaloes.

The influence of calving and uterine health status on the subsequent fertility performance was highly significant. The animals which suffered from uterine health problems alone or both calving abnormalities and uterine health problems were more susceptible to subsequent fertility problems. Since most of the severe cases of calving abnormalities were already associated with various uterine health problems, the animals suffered from both uterine health problems and abnormal calvings were found to be associated with higher incidence of anoestrus.

The analysis of incidence of repeat breeding using multiple logistic regression model with season of calving, period of calving, parity and calving and uterine health status as independent variables revealed that all the effects except parity were significantly contributing to the variation in this trait in Murrah buffaloes. Rahman *et al.* (1997), Taraphder *et al.* (2007) and Kumar and Singh (2009) also reported non-significant influence of parity on repeat breeding cases of buffaloes.

The incidence of repeat breeding was highest in buffaloes calved during autumn (14.81%) and lowest among those calved during rainy season (9.64%). The animals calved during autumn and summer were reported to have higher ODDS in favour of developing repeat breeding in comparison to those calved during rainy season and winter. Singla and Verma (1994), Taraphder *et al.* (2007) and Kumar and Singh (2009) reported significant seasonal variation on the incidence of repeat breeding. However, Rahman *et al.* (1997) failed to observe any significant effect of season of calving on repeat breeding. The present investigation also revealed significant variation across different periods with respect to the incidence of repeat breeding cases. On the other hand, Singla and Verma (1994) and Taraphder *et al.* (2007) reported nonsignificant period effect on repeat breeding.

Similarly, higher incidence of fertility problems was associated with abnormal calvings and uterine health problems. Group of animals affected with uterine health problems alone and both abnormal calvings and uterine health problems showed higher ODDS in favour of developing fertility problems (6.43 and 5.05, respectively) in comparison to normal buffaloes (1.00).

The overall incidence of fertility problems was 40.22% incorporating 34.26% cases of anoestrus and 11.56% cases of repeat breeding. The results revealed higher ODDS ratio in favour of fertility problems in buffaloes calved during winter (1.36) and summer (1.27) in comparison to those calved during rainy (0.81) season. The ODDS ratio in favour of developing fertility problems was 3.35 and 3.16 for animals affected with uterine health problems alone or both calving abnormalities and uterine health problems in comparison to animals with normal calving and uterine health status (1.00). The incidence of anoestrus was highest among animals calved during winter season (41.17%) in comparison to those calved during rainy season (28.70%). The incidence of true anoestrus also revealed similar influence of season of calving; whereas, anoestrus PCL was not affected significantly by season of calving. The buffaloes calved during autumn and summer showed higher ODDS (1.00 and 0.96) in favour of developing repeat breeding in comparison to those calved during rainy season (0.64) and winter (0.69). The significant influence of various non-genetic factors revealed the importance of better management practices to alleviate the effect of these factors in the reproductive performance of Murrah buffaloes in the tropical climatic conditions.

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