Journal of Animal Research: v.9 n.5, p. 633-644. October 2019

DOI: 10.30954/2277-940X.05.2019.2

Study of Incidence of Reproductive Disorders in Murrah Buffaloes in Relation to Non- Genetic Factors through an Animal Model

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Received: 29 July, 2019 **Revised:** 08 Sept., 2019 **Accepted:** 12 Sept., 2019

ABSTRACT

The present investigation was carried out on 459 Murrah buffaloes affected with some reproductive problem with 618 calving records (out of total 1336 Murrah buffaloes) over a period of 12 years from 2007 to 2018 at GADVASU, Ludhiana. The overall incidence of dystocia, retention of placenta (ROP), anestrus, repeat breeding (RB),postpartum abnormal discharge (PPAD) and abortion w.r.t. total number of animals were 0.9, 0.3, 3.3, 9.3, 12.3, 13.3 and 6.2%, respectively and w.r.t. affected animals were 2.8, 9.8, 27, 35.7, 38.8 and 18.1%, respectively. Parity of calving had significant effect ($P<0.05$) on ROP and anestrus. Season had significant ($P<0.05$) effect on dystocia and ROP. Period had highly significant effect ($P<0.01$) on dystocia, anestrus, RB and abortion while significant effect on PPAD. Results indicated that incidence of RB, PPAD and ROP increases as the animal become older. Further incidence of dystocia are higher during first and last parities whereas incidence of anestrus are more during earlier parities (in heifers). Incidence of ROP and PPAD are more during rainy season. Incidence of dystocia and anestrus are more during winter season whereas incidence of abortion are more during summer season. Overall incidence revealed a reduction in reproductive disorders in latter periods showing progressive improvement in management of reproduction problems over period.

Keywords: Murrah Buffalo, Reproductive disorders, Incidence

India is principally an agriculture oriented country and livestock is a fundamental element of agriculture. Regardless of our large human population, India has been able to achieve self-sufficiency in food grain production through "green revolution". It has resulted in increase in food grain production from 82 million tonnes during 1960-61 to a record production of 281.37 million tonnes in 2018-19 (Department of Agriculture). It is quite an encouraging to know that a remarkable progress has been made in milk production through "white revolution". The milk production has increased from 155.5 million tonnes in 2015-16 to 165.4 million tonnes in 2016-17 with a growth of 6.4% (DADHF, 2017).

Buffaloes are known as Indian milking machine. The superiority of buffalo over local cow with regard to milk production is widely accepted in India. Indians have predilection for buffalo milk and it is for this reason that the population of buffaloes is increasing day by day (Taraphder, 2002). Buffaloes contribute about fifty percent of the total milk production of our country though contributing to only one-third of the total bovine population (DADHF, 2012). India is fortunate enough to have the world's best breeds of buffaloes. Special attention has to be made to Murrah breed of buffaloes whose breed average is about 2200 kg per lactation (Taraphder, 2002) and it contributes 44.39% of total buffalo population (DADHF, 2017). Avoidably of

How to cite this article: Singh, P., Sodhi, S.S., Dash, S.K., Kaur, S., Malhotra, P. and Dhindsa, S.S. (2019). Study of incidence of reproductive disorders in murrah buffaloes in relation to non- genetic factors through an animal model. *J. Anim. Res.,* **9**(5): 633-644.

superior germplasm of Murrah buffaloes in India gives us an opportunity to help other buffalo breeding countries in breed improvement programmes by shipping frozen semen to their destination. Therefore, all the countries of the world look forward to India for improvement of their native poor quality buffalo breeds. Hence, there is a dire need that we should exploit our high quality Murrah buffaloes for further improvement of their performance. Inspite of its unique ability to make ends meet under harsh condition, the buffaloes have been neglected by breeders and research scientists. Buffaloes are reputed as an efficient converter of low grade, fibrous feeds into high value milk with adaptation to wide ecological conditions (Kumar *et al*., 2017). To make dairying a successful and profitable business, buffaloes should not only be the high producer but also be high yielder, healthy, disease free and regular breeder. A low incidence of disease, mortality, and regular breeding may help to increase the selection differential thereby genetic improvement. Further, inspite of buffaloes significant role as a milk producer, it did not find its desired place in scientific literature, especially w.r.t. health and survivability information coupled with specific reference to reproductive disorders.

Culling of buffaloes because of reproductive problems accounts for a great loss of milk production as well as offspring (Khan *et al.,* 2009). Reproductive disorders and lower fertility condenses the income to dairy farmer by decreasing milk yield and reproduction. Further high veterinary expenses in addition to reduction in longevity of buffaloes also create burden. Therefore it has been observed that reproductive disorders are economically more important than any other traits under selection.

Among the reproductive disorders, repeat breeding (RB), anestrus, retention of placenta (ROP), and abortion are the most important livestock maladies affecting a variety of livestock species including cattle and buffaloes. The reproductive disorders affect the dairy industry with profound economic loss and trade impact in India (Khan *et al.,* 2016). The information on the incidence of diseases in dairy cattle of advanced countries is well documented, but such estimates are scanty for Indian breeds of cattle and especially in buffaloes probably no information is available.

Keeping in view the above aspects, the present study was envisaged to investigate of reproductive disorders in the murrah buffalo herd maintained at dairy farm, Guru angad dev veterinary and animal sciences university (GADVASU), Ludhiana.

MATERIALS AND METHODS

Location

The present study was carried out on Murrah buffalo herd maintained at the dairy farm of the Directorate of Livestock Farms (DLF), GADVASU, Ludhiana.

Source of data

The data pertaining to the reproductive problems of Murrah buffaloes were collected from the records and history sheets maintained at DLF, GADVASU, Ludhiana.

Management and feeding of herd

The animals were kept in loose housing system with one third shaded area at the dairy farm. Ad-libitum feeding and free access to water was practiced. The animals were housed separately on the basis of their age and production levels.

The weaning of calves was done immediately after birth and then they were fed on colostrum for first five days and then whole milk from sixth day to sixteen weeks of age.

All the female animals were bred through artificial insemination. Animals in advance stage of pregnancy were segregated to calving pens at least six weeks before the expected date of calving. Body weights were recorded by weighing the animals monthly in the morning before feeding and newly born were weighed before colostrums feeding.

The maintenance and growth ration were fed to the animals in the morning hours once a day and feeding total mixed ration (TMR) was practiced post 2012. While production ratoin was given to the milking buffaloes at the time of milking. Concentrate ration (CP= 18% and TDN= 70%) were formulated using cereals, cakes, brans, mineral mixture, salt and additives depending upon season and physiological status (age, production, stage of pregnancy etc.) of animal.

Information of Murrah buffaloes

General information e.g. animal number, dam number, sire number, date of successful service, total number of artificial insemination done, date of calving (upto 6th calving), types of calving in each lactation (upto 6th calving) and parity number (upto 6th parity) was collected for the identification and classification of Murrah buffaloes.

Information regarding reproductive disorders

The information pertaining to reproductive disorders since January 2007 to December 2018, recorded on the Murrah buffaloes of the herd maintained at GADVASU was compiled. The various reproductive disorders to be incorporated in the current study were divided into two main categories i.e. periparturient complications which included dystocia, still birth (SB), premature birth and retention of placenta (ROP) and successively other reproductive problems such as anestrus, repeat breeding (RB), prolapse, postpartum abnormal discharge (PPAD) and abortion.

Data structure

The data on reproductive disorders were collected from the records maintained at dairy farm GADVASU, Ludhiana. Data comprised of records on calving, reproductive performance and reproductive disorders. The study included 618 calving records of 459 Murrah buffaloes (affected with any of the reproductive disorders mentioned above), from total of 1336 Murrah buffaloes.

The records of Murrah buffalo with known pedigree were used for analysis of reproductive disorders. Animals with improper records were not included in the study.

Classification of non-genetic factors

Non- genetic factors viz. Parity, Period and Season of calving were classified into subclasses to assess the effect of non-genetic factors on different reproductive traits.

Parity

Parities were taken into consideration upto recent lactation recorded in the available reproduction sheets of the herd. The data were classified for different parities upto sixth parity and each parity was coded starting from code "1" to code "6" upto sixth parity.

Period of calving

The data on reproductive disorders from a span of 12 years were classified into 4 periods with each period covering 3 years of duration (Table 1).

Table 1: Classification of period

Period of calving	Codes of the period
January 2007 - December 2009	1
January 2010 - December 2012	2
January 2013 - December 2015	3
January 2016 – December 2018	4

Season of calving

The months of an year were grouped into 4 seasons on the basis of prevailing climatic conditions of Punjab. December to February, had been classified as Winter season, followed by March to May as Summer season. The Rainy season had be regarded as from months June to August whereas the following months from September to November were classified as Autumn season.

STATISTICAL ANALYSIS

For statistical analysis of the data, Statistical analysis system software programme (SAS, 2011) version 9.3 was used. The means, standard deviations, standard error were estimated by using standard statistical procedures. The effect of non-genetic factors like parity, season and period of calving were estimated by using chi- square and p value less than 0.05 at 5% level of significance were considered as statistically significant and *p* value less than 0.01 at 1% level of significance were considered as statistically highly significant.

Estimation of effects of non- genetic factors on various reproductive disorders

The effect of non-genetic factors like parity, season and period of calving on the incidence of various reproductive disorders were studied and were calculated by taking the

proportion of affected animals in the herd. The effect of non-genetic factors were estimated by conducting the analysis of various non-genetic factors using logistic regression.

$$\hat{Y} = a + b_1x_1 + b_2x_2 + b_3x_3 + e$$

Where:

$\hat{Y}$ = Outcomes of affected/ non-affected

a = intercept for the regression model

x_1 = period

b_1 = partial regression coefficient for x_1 (period)

x_2 = parity

b_2 = partial regression coefficient for x_2 (Parity)

x_3 = Season of calving

b_3 = partial regression coefficient for x_3 (Season of calving)

e = Random error

RESULTS AND DISCUSSION

Overall incidence of reproductive disorders

The findings of the present study revealed that overall incidence of dystocia, SB, ROP, anestrus, repeat breeding, prolapse, PPAD and abortion in Murrah buffaloes was 2.8, 1.1, 9.8, 27, 35.7, 1.3, 38.8 and 18.1% respectively while none of the incidence of premature birth had been found in our study (Table 2). The details pertaining to the total number of records, the number animals affected and percentage incidence of various reproduction disorders have been depicted in Table 2. At the same time it has been observed that, average incidence of dystocia and SB, had been reported to be less than 1.0% w.r.t. whole herd. Moreover, range of reproductive disorders observed had been from 0.3% (SB) to 13.3% (PPAD) w.r.t. whole number of animals under study (Table 2).

The numbers of buffaloes with dystocia were 13 out of 459 total abnormal calving animals which were 2.8%. Almost parallel estimates of dystocia in Holstein crossbreds were reported by Kulkarni *et al.* (2002), 3.32-3.84 in Karan fries cows by Balasundaram (2008) and higher estimates (6.9%) were observed by Gaafar *et al.* (2010) in cows. On the other hand, lower incidence of overall dystocia i.e. 1.78% were reported by Taraphder (2002) in Murrah buffaloes.

The overall incidence of ROP has been reported to be 9.8% among 459 total abnormal calvers. The present findings of the current study w.r.t. overall incidence are in close agreement with the incidence obtained in an earlier study (9.72% and 8.63%) by Rahman *et al.* (1997) and Taraphder (2002) in Murrah buffaloes. Higher incidence

Table 2: Overall incidence of reproductive disorders in Murrah buffaloes

Variable	Dystocia	Still birth	Retention of placenta	Anestrus	Repeat breeding	Postpartum abnormal discharge	Abortion
Average incidence w.r.t. abnormal calvers	2.8% (13)	1.1% (5)	9.8% (45)	27% (124)	35.7% (164)	38.8% (178)	18.1% (83)
Total no. of animals with reproductive disorders				459			
Average incidence w.r.t. total animals	0.9	0.3	3.3	9.3	12.3	13.3	6.2
Total no. of animals from 2007-2018				1336			

were reported by Balasundaram (2008) in Karan fries cows. While the lower estimates for ROP have also been reported for Nagpuri and Murrah buffaloes (Kaikini *et al.,* 1976; Rawal and Singh 1991; Tomar and Tripathi 1994 and Prasad and Prasad, 1998). Studies of Murugeppa and Dubey (1998) also support similar trend for Surti buffaloes. Further, findings of Dutta and Dugweker (1983) for cows and buffaloes and Kumar (1988) for rural buffaloes have also reported contrast estimates.

In case of anestrus, the overall incidence was 27% among 459 total abnormal calving animals and 9.3% incidence had been recorderd out of total herd in the present study. It reflects that nearly one fourth (124) Murrah buffaloes out of the abnormal calvers did not come in estrus within 90 days postpartum. Similar incidence of anestrus has been reported by Singh *et al.* (1989) and Gautam *et al.* (1992) for buffaloes and about 28.62% incidence were reported by Taraphder (2002) for Murrah buffaloes. Balasundaram (2008) reported lower incidence i.e. 22.51 and 18.48% in Karan Fries first calvers and all calvers.

The overall incidence of repeat breeding was 35.7% among 459 total abnormal calving animals which touched the level of 12.3% among the total 1336 animals. Buffaloes were said to be repeat breeder if they failed to conceive after atleast 3 successive inseminations. About one third of the abnormal calvers were reported to be repeat breeder in the current study. Almost similar incidence (31.95%) of repeat breeding has been reported in crossbred cattle and higher incidence were reported in non-descript cattle (68.05%) (Maji *et al*., 2013). Studies conducted by Tomar and Tripathi (1986) for Murrah and Kodagoli (1968) for Jaffarabadi buffaloes have reported lower estimate of repeat breeding. Further Taraphder (2002) for Murrah buffaloes (12.14%) and Balasundaram (2008) for first calvers (10.74) and all calvers (11.67%) in Karan Fries cows have reported contrast results to the current study.

The highest overall incidence 38.8% of PPAD was recorder among 459 reproductively affected animals and 13.3% among the whole herd. The present findings in Murrah buffaloes for overall incidence are in close agreement with the reports of an earlier study (38%) by Oltenacu *et al*. (1983) in Holstein cows. While the lower estimates for postpartum abnormal discharge were found by LeBlanc *et al*. (2002) in Cattle.

The cases of abortion were 18.1% in abnormal calving animals (459) and 6.2% in whole herd, whereas 6.55% incidence of abortion had been reported by Taraphder (2002) in Murrah buffaloes and 3.32% by Balasundaram (2008) in Karan Fries cows. Lower incidence of abortion had been reported in crossbred cows (Roy and Tripathi, 1989; Urade, 2001 and Chourewar *et al.,* 2002).

Incidences of reproductive disorders in relation to various non-genetic factors

Dystocia

Chi square analysis revealed that parity had non-significant effect on the incidence of dystocia. However, a regular trend was observed among the parities. Highest incidence of dystocia was observed in the sixth parity and the incidence was also high in earlier parities (Table 3). Similar trends w.r.t. parity has also been observed for Murrah buffaloes in earlier studies (Tomar and Verma, 1987; Tomar and Ram, 1993; Tomar and Tripathi, 1995). Further, significant effect of parity on dystocia was reported by Tomar (1984) and Taraphder (2002) for Murrah buffaloes. Logistic regression analysis revealed that fifth parity has 100% less chances of dystocia while first, second, third, fourth and fifth parities have 41,54,23,60 and 100% respectively less chances of dystocia as compare to sixth parity (Table 6).

The incidence of abnormal dystocia was found to be highest among those calved during winter season (6.8%) and lowest among those calved during rainy (0.8) and autumn (1.0%) season (Table 4). The effect of season of calving was found to be significant ($P<0.05$) on dystocia. Although non-significant effect of season of calving ondystocia has been reported by Taraphder (2002) in Murrah buffaloes and Balasundaram (2008) in Karan swiss cows. It has been revealed from logistic regression that winter (1) and summer (2) season had 3.37 and 1.48 times more chances of dystocia while rainy (3) season has 0.25 times less chances of dystocia as compare to autumn season (Table 6).

Highly significant effect of period on the incidence of dystocia has been observed. The average incidence of dystocia varied from 0.0 to 10.9% during different period under study. The highest incidence (10.9%) of dystocia was found during third period i.e. January 2013- December 2015 and lowest (0.0%) during second period i.e. January

Table 3: Incidence (%) of reproductive disorders in different parities in 459 Murrah buffaloes

Variable	Factor	Level	Observed count	Total count	Incidence	P value
Dystocia	Parity	1	6	184	3.2%	0.666
		2	3	102	2.9%	
		3	2	78	2.5%	
		4	1	42	2.4%	
		5	0	34	0	
		6	1	19	5.3%	
Retention of placenta	Parity*	1	12	184	6.5%	0.026
		2	11	102	10.8%	
		3	6	78	7.7%	
		4	8	42	19.0%	
		5	3	34	8.8%	
		6	5	19	26.3%	
Anestrus	Parity*	1	64	184	34.8%	0.025
		2	19	102	18.6%	
		3	22	78	28.2%	
		4	9	42	21.4%	
		5	8	34	23.5%	
		6	2	19	10.5%	
Repeat breeding	Parity	1	60	184	32.6%	0.721
		2	41	102	40.2%	
		3	28	78	35.9%	
		4	13	42	31.0%	
		5	14	34	41.2%	
		6	8	19	42.1%	
Postpartum abnormal discharge	Parity	1	67	184	36.4%	0.253
		2	41	102	40.2%	
		3	27	78	34.6%	
		4	20	42	47.6%	
		5	18	34	52.9%	
		6	5	19	26.3%	
Abortion	Parity	1	30	184	16.3%	0.966
		2	19	102	18.6%	
		3	16	78	20.5%	
		4	8	42	19.0%	
		5	7	34	20.6%	
		6	3	19	15.8%	

* ($P< 0.05$).

2010- December 2012 (Table 5). Non-significant effect of period of calving has been reported by Taraphder (2002) in Murrah buffaloes and Balasundaram (2008) in Karan fries cows. Further from logistic regression it has been analysed that third period had 4.06 times more chances of dystocia while first and second periods have 0.63 and 2 times less chances of dystocia as compare to period fourth (Table 6).

Retention of placenta

Except third and fifth parities, an overall increasing trend of incidence of ROP was observed in different parities as shown in Table 3. Incidence of ROP was maximum in sixth parity (26.3%) and lowest in the first parity (6.5%). The parity of calving has significant effect ($P<0.05$) on the incidence of retention of placenta. Similar trend has also been reported by Singh and Rao (1957), in buffaloes which states that higher incidence (12.61 %) was observed in fourth and fifth parity and zero in the first parity. While Taraphder (2002) observed that except sixth and above parity, non-significantly decreasing trend of incidence of

retention of placenta among the parity was observed. It has been concluded that the highest incidence of retention of placenta in sixth and above parity may be due to more relaxation of genitalia and weak muscle tonicity which subsequently lead to failure to expel placenta from genitalia. Logistic analysis revealed that first parity has 81.2% less chances of retention of placenta w.r.t. sixth parity while second, third and fourth parity has 66.4, 76.4 and 30% less chances of retention of placenta w.r.t. sixth parity (Table 6). As far as, the effect of season is concerned, it has been observed that the Murrah buffaloes calved in winter season had significantly (P<0.05) lower incidence (4.5%) of ROP, followed by autumn (8.7%), summer (12.4%) and rainy (14.3%) season (Table 4). The present findings are in close agreement with Bhalaru *et al.* (1983) and Balasundaram (2008) who reported that incidence of ROP was significantly higher in rainy season than other seasons. Prasad and Prasad (1998), also reported that season of calving has significant effect on ROP for Murrah buffaloes. While, Rawal and Singh (1991) and Taraphder (2002) had reported contradicted results stating non-significant effect of season on retention of placentain Murrah buffaloes. Further from the logistic regression analysis it has been observed that rainy (3) and summer (2) season has 102.1 and 66.1% more chance of retention of placenta as compare to autumn but winter (1) season has 34.5% less chances of retention of placenta as compare to autumn (4) (Table 6).

Statistical analysis showed the non- significant effect (P<0.05) of period of calving on ROP. No regular trend was observed for ROP but incidence of ROP decreased from first period (8.95%) to fourth period (8%) except second period (11.1%) of the current study (Table 5). Moreover, significant effect of period of calving on ROP has also been reported by Tomar and Tripathi (1994) and Taraphder (2002) for Murrah buffaloes and Balasundaram (2008) in Karan Fries cows. Parallel results showing non- significant effect was reported by Tomar and Tripathi (1983) and Bhalaru *et al.* (1983) for Murrah buffaloes. This trend may be attributed to the changes in the environmental conditions. For period, estimation of logistic regression reveals that third period has 53.7% less chances of retention of placenta while first and second period has 13.8% and 54% more chances of ROP w.r.t. fourth period.

Table 4: Incidence of reproductive disorders in different seasons in 459 Murrah buffaloes

Variable	Factor	Level	Observed count	Total count	Incidence	P value
Dystocia	Season*	Winter	9	133	6.8%	0.012
		Summer	2	89	2.2%	
		Rainy	1	133	0.8%	
		Autumn	1	104	1.0%	
Retention of placenta	Season*	Winter	6	133	4.5%	0.045
		Summer	11	89	12.4%	
		Rainy	19	133	14.3%	
		Autumn	9	104	8.7%	
Anestrus	Season	Winter	39	133	29.3%	0.699
		Summer	26	89	29.2%	
		Rainy	35	133	26.3%	
		Autumn	24	104	23.1%	
Repeat breeding	Season	Winter	49	133	36.8%	0.134
		Summer	29	89	32.6%	
		Rainy	40	133	30.1%	
		Autumn	46	104	44.2%	
Postpartum abnormal discharge	Season	Winter	51	133	38.3%	0.494
		Summer	29	89	32.6%	
		Rainy	57	133	42.9%	
		Autumn	41	104	39.4%	
Abortion	Season	Winter	21	133	15.8%	0.678
		Summer	19	89	21.3%	
		Rainy	26	133	19.5%	
		Autumn	17	104	16.3%	

* (P< 0.05).

Table 5: Incidence of reproductive disorders in different periods in 459 Murrah buffaloes

Variable	Factor	Level	Observed count	Total count	Incidence	P value
Dystocia	Period**	1	1	134	0.7%	0.00
		2	0	133	0.0%	
		3	10	92	10.9%	
		4	2	100	2.0%	
Retention of placenta	Period	1	12	134	8.95%	0.137
		2	15	133	11.1%	
		3	4	92	4.35%	
		4	8	100	8.0%	
Anestrus	Period**	1	29	134	21.6%	0.008
		2	34	133	25.6%	
		3	19	92	20.65%	
		4	19	100	19.0%	
Repeat breeding	Period**	1	75	134	56.0%	0.000
		2	50	133	37.6%	
		3	26	92	28.3%	
		4	13	100	13.0%	
Postpartum abnormal discharge	Period*	1	42	134	31.3%	0.015
		2	59	133	44.4%	
		3	29	92	31.5%	
		4	28	100	28.0%	
Abortion	Period**	1	12	134	9.0%	0.006
		2	28	133	21.1%	
		3	17	92	18.5%	
		4	8	100	8.0%	

* ($P< 0.05$), ** ($P<0.01$).

Anestrus

The findings of the present study revealed that the incidence of anestrus varied from 10.5-34.8% among different parities. Age of buffaloes in terms of parity had significant ($P<0.01$) effect on the incidence of anestrus which decreased with the increase in parity number except second and fifth parity (Table 3). Highly significant effect of parity on incidence of anestrus had also reported in Murrah and Jaffarabadi buffaloes (Pandit *et al.,* 1982; Tomar and Tripathi, 1985; Singh *et al.,* 1986; Gautam *et al.,* 1992; Singla and Verma, 1994 and Tharaphder, 2002) for Jaffarabadi buffaloes. A non-significant effect was also observed by Balasundaram (2008) in Karan fries cows. Incidence of anestrus being highest in heifers indicated that the heifers cope up with increasing demand of energy and minerals. In younger buffaloes most of the part of their energy is utilized for milk production and in building up their body as a protective mechanism to conserve their own body reserve (Roberts, 1971) and the left out energy is inadequate for performing reproductive functions. Inadequate nutrition suppresses estrus in young growing females more than it does in old females leading to ovarian inactivity and anoestrous (Hafez, 1974). Therefore, increasing the level of energy and mineral supplements could able to cope with this negative energy balance. It has been revealed from the logistic regression analysis that there are 320.8, 80.2, 185.6, 87 and 241.4% more chances of anestrus in first, second, third, fourth and fifth parities than sixth parity (Table 6).

The Murrah buffaloes calved in winter and summer season had higher incidence of anestrus than rainy and autumn season (Table 4). But there was no significant effect of season of calving on incidence of anestrus in present study, although Singla and Verma (1994); Taraphder (2002) for Murrah buffaloes and Gautam *et al.* (1992) for Jaffarabadi buffaloes reported that season had significant effect on anoestrous. On the contrary, Singh *et al.* (1986) found that season of calving has non-significant effect on the incidence of anestrus. Further, statistical analysis of our study had also revealed that winter season had 1.8% less chances of anestrus than autumn. On the other hand summer and rainy season had 25.5 and 0.70% more chances of anestrus w.r.t. autumn (Table 6).

Table 6: Logistic regression of reproductive disorders w.r.t. parity, period and season of calving in Murrah buffaloes

Factor	Level	Odds Ratio					
		Dystocia	ROP	Anestrus	RB	PPAD	Abortion
Parity	1	0.59	0.188	4.208	0.707	1.696	1.027
	2	0.46	0.336	1.802	0.924	2.111	1.263
	3	0.77	0.236	2.856	0.748	1.606	1.344
	4	0.40	0.700	1.870	0.568	2.920	1.236
	5	0.00	0.237	2.414	1.016	3.428	1.307
Season	1	3.37	0.655	0.982	0.765	1.148	0.968
	2	1.48	1.661	1.255	0.627	0.755	1.364
	3	0.75	2.024	1.070	0.493	1.220	1.279
Period	1	0.37	1.138	1.231	8.908	1.180	0.277
	2	0.00	1.542	1.383	4.228	1.623	0.738
	3	4.06	0.473	1.176	2.769	1.189	0.660

Moreover, the period had highly significant ($P<0.01$) effect on the incidence of anestrus. The incidence of anestrus follows the decreasing pattern from second period (25.6%) to fourth period (19.0%) whereas incidence during first period were (21.6%) (Table 5). Pandit *et al.* (1982), Tomar and Tripathi (1985) and Taraphder (2002) also found highly significant effect of period for Murrah buffaloes. On the other hand non- significant effect was observed by Balasundaram (2008) in Karan fries cows. From logistic regression it has been analysed that period first, second and third has 1.231, 1.383 and 1.176 times more chances of anestrus w.r.t. fourth period (Table 6).

Repeat breeding

The present study indicated that parity had no significant effect on RB and no regular trend for incidence of repeat breeding among the parities has been observed. The incidence of repeat breeding was found to be lower in first, third and fourth parities (32.6%, 36.9% and 31.0%) w.r.t. second, fifth and sixth parities (40.2%, 41.2%% and 42.1%) (Table 3). Similarly, non-significant effect of parity on repeat breeding has also been reported in Murrah buffaloes (Pandit *et al.,* 1982; Rahman *et al.,* 1997 and Taraphder, 2002). Logistic regression analysis also revealed that second parity has 7.6% less chances of repeat breeding as compare to sixth parity whereas first, third, fourth and fifth parity has 29.3, 25.2 and 43.2% less chances of repeat breeding w.r.t. sixth parity (Table 6).

Season of calving had non-significant effect on the incidence of repeat breeding. The incidence of repeat breeding was found to be higher in autumn (44.2%) followed by winter (36.8%) and summer season (32.6%) whereas least incidence has been recorded in rainy season (30.1%) (Table 4). Non-significant effect of season of calving has been also reported by Singh *et al.* (1983) and Rahman *et al.* (1997) for buffaloes. While significant effect of season of calving on the incidence of repeat breeding has been reported by Singla and Verma (1994) and Taraphder (2002) for Murrah buffaloes. From logistic regression, it had been observed that in rainy season (3) 50.7% less chances of occurence of repeat breeding while winter (1) and summer (2) season have 23.5 and 37.3% less chances of repeat breeding as compare to autumn (Table 6).

Higher incidence of reproductive problems in winter season could be due to stressful conditions during this month. Protection against chilly winds during winter months may reduce the occurrence of reproductive problems in Murrah buffaloes.

A decreasing trend of incidence of repeat breeding has been observed from first period (56%) to fourth period (13%) of this study (Table 5). Highly significant effect of period of calving on incidence of repeat breeding was observed. Similar results has been reported by Tomar (1984) in Murrah buffaloes and Mukherjee *et al.* (1993) in Karan Fries cows. However, non-significant effect was observed by Taraphder (2002) in Murrah buffaloes and Balasundaram (2008) in Karan fries cows. Results obtained from logistic regression showed that period first has 8.9 times more chances of repeat breeding as compare

to fourth period whereas second and third period has shown the decreasing trends w.r.t. first period but 4.2 and 2.7 times more chances of repeat breeding as compare to fourth period (Table 6).

Postpartum abnormal discharge

Parity had non-significant effect on the incidence of PPAD. Except third (34.6%) and sixth parities (26.3%) higher incidence (36.4- 52.9%) of PPAD among the parity were observed (Table 3). Similar trends w.r.t. parity has also been observed for Murrah buffaloes in earlier study (Taraphder, 2002). Further, it has also been revealed from logistic regression that fifth parity has highest (3.4 times more) chances of PPAD w.r.t sixth parity followed by fourth, second, first and third parities i.e. 2.92, 2.22, 1.69 and 1.60 times respectively (Table 6).

Season of calving had non-significant effect on the incidence of PPAD during the present study. The incidence of PPAD was found to be higher in rainy season (42.9%) and lowest (32.6%) in summer season (Table 4). Non-significant effect of season of calving was reported by Taraphder (2002) in Murrah buffaloes. Logistic regression has shown that summer season (2) has 24.5% less chances of postpartum abnormal discharge as compared to autumn. Contrary to this rainy (3) and winter season (1) has 22 and 14.8% more chances of postpartum abnormal discharge w.r.t. autumn season (Table 6).

Period has shown significant effect on the incidence of PPAD which follows decreasing pattern of incidence of the trait from period first (31.3%) to period fourth (48%) except slight increase in second period (44.4%) (Table 5). It has been revealed using logistic regression that first, second and third period has 1.18, 1.623 and 1.189 times more chances of postpartum abnormal discharge as compare to fourth period (Table 6).

Abortion

Though parity had no significant effect on abortion but sixth parity had the lowest (15.8%) incidence of abortion (Table 3). Moreover, no specific trend has been recorded for the incidence of abortion across the different parities. The present findings are in close agreement with findings of Prabhu and Chatterjee (1970); Sharma and Jain (1982) and Balasundaram (2008) who also reported that parity had non-significant on the incidence of abortion in crossbred cattle. Logistic regression resuts shows that first parity has almost same (2.7% more) chances of occurence of abortion as compare to sixth parity. While second, third, fourth and fifth parity has 26.3, 34.4, 23,6 and 30.7% more chances of abortion as compare to sixth parity (Table 6).

Season of calving had non-significant effect on the incidence of abortion but the buffaloes calved in summer season had highest (21.3%) incidence of abortion and those calved in winter (15.8%) season had lowest incidence of abortion (Table 4). Balasundaram (2008) and Bhat *et al.* (2016) also reported that higher frequency of abortion was observed in cows during summer season than other seasons. Non-significant effect of season of calving was reported by Sharma and Luktuke (1983) in crossbred cows, whereas significant effect of season of calving on the incidence of anestrus has been reported by Taraphder (2002). Further, the summer and rainy seasons have been recorded to have 36.4 and 27.9% more chances of abortion as compare to autumn. While winter season has 3.2% less chances of abortion as compare to autumn season (Table 6).More number of abortion cases in summer months may be due to extreme weather stress thereby indicating the need of amelioration of stress during these months of inclement weather conditions for improving overall reproductive efficiency of Murrah buffaloes.

Period has highly significant ($p< 0.01$) effect on the incidence of abortion (Table 5). Incidence of abortion decreases from second period (21.1%) to fourth period (8%) except first period (9.0%). Taraphder (2002) in Murrah buffaloes and Balasundaram (2008) in Karan fries cows found non-significant effect of period of calving on this trait. It has also been revealed that first period has 72.3% less chances of abortion while second and third period has 26.2 and 34% less chances of abortion as compare to fourth period (Table 6).

CONCLUSION

From the current study, it has been observed that incidences of reproductive problems are less in the herd maintained at the dairy farm of GADVASU. Further improvement in the reproductive problems has been observed over the period which means there is a progressive improvement in the pre- and post-partum management of the buffaloes. Moreover, it has been observed that incidences of RB,

PPAD and ROP increase as the animal become older, whereas incidences of dystocia are higher during first and last parities. At the same time it has been concluded that incidence of anestrus are more during earlier parities (in heifers). Further incidence of ROP and PPAD increase during rainy season. Chances of dystocia and anestrus are higher during winter season whereas chances of abortion are more during summer season.

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