Production and Reproductive Performance of Bhadawari Buffaloes in Uttar Pradesh, India

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Abstract: Bhadawari is one of the recognized buffalo breeds of India and is famous for high fat content in their milk. Data on production and reproductive traits were collected under Network Project on Bhadawari buffaloes, at Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh, India. The overall least squares means (±SE) for peak yield, days to attain peak yield, lactation milk yield, lactation length, 305 days milk yield, milk yield per day of lactation, service period, calving interval and dry period were 6.96±0.10 kg, 52.8±4.1 days, 1250.5±24.6 kg, 291.4±4.9 days, 1213.5±21.6 kg, 4.30±0.06 kg, 172.4±7.7 days, 522.1±12.1 days and 241.80±11.3 days, respectively. Period of calving had a significant ($p<0.05$) to highly significant ($p<0.01$) effect on all the traits studied except service period and dry period, where it was not significant. Season of calving had a significant ($p<0.05$) effect or lactation length and highly significant ($p<0.01$) effect on lactation milk yield, 305 days milk yield and all the reproductive traits under study. The lowest calving interval, service period and dry period were observed in rainy season calvers and they differed significantly ($p<0.01$) with winter and summer calvers. Parity had a significant effect ($p<0.05$) on lactation milk yield, 305 days milk yield and milk yield per day of lactation. Pair-wise comparison revealed that lactation milk yield was highest in the 2nd lactation followed by 3rd and 4th lactation. Large coefficient of variation observed for different traits under study indicates that there is enough scope for improvement in the production and reproduction traits. Better breeding management and selection for increased performance is needed for genetic improvement of these traits.

Keywords: Bhadawari, buffaloes, production, reproduction, non-genetic factors.

INTRODUCTION

India possesses the best buffalo breeds of the world. There are 13 recognised breeds and several non-descript breeds in the country, which have regional importance and add to the economic value of the farming community (http://www.nbagr.res.in/regbuf.html). Bhadawari is one of the recognized buffalo breeds of India and is famous for high fat content in their milk. Bhadawari buffaloes are geographically distributed in the ravines of Yamuna and Chambal rivers spread over in Uttar Pradesh and Madhya Pradesh states of India. The main breeding tract is Agra and Etawah in Uttar Pradesh and Bhind and Morena district in Madhya Pradesh. The tract was a part of the erstwhile Bhadawar estate from where the name of this breed originated. Bhadawari, the brown beauty of ravines and predominantly the only breed to have adapted to the harsh conditions of the ravines with undulating topography, thorny and scanty bushes, climatic stress and draught conditions. They are also known for eating less and producing more [1]. Calf mortality is significantly lower than the other breeds of buffaloes [2]. Male animals are good for agriculture work especially for ploughing in rice fields [3]. The buffaloes are of medium size with medium milk yield but the fat content in their milk may go as high as 13 per cent [4]. With the pace of development bringing canals for irrigation, thereby increasing the agricultural production has seen large influx of high yielding Murrah into the breeding tract of the Bhadawari. To increase the milk production, indiscriminate crossbreeding with Murrah buffaloes during the last 3 to 4 decades has almost wiped out the Bhadawari buffaloes in its breeding tract. The population of Bhadawari buffaloes in Uttar Pradesh was 1.139 lakhs during the year 1977 and, it reduced to 0.982 lakhs in year 1991 [5]. A similar trend was also reported by Kushwaha *et al*. [6], who conducted the survey and reported an estimated population of Bhadawari buffaloes around 40,000. Looking into the urgency to conserve this gene pool, Indian Council of Agricultural Research has initiated efforts on conservation and improvement of Bhadawari buffaloes at Indian Grassland and Fodder Research Institute, Jhansi (IGFRI) under Network program on buffaloes in the year 2001.

The performance reported in the literature [7] revealed that the milk production (657.9 to 1165 kg per lactation) of Bhadawari buffaloes is comparatively poor than the other dairy breeds of buffaloes and the poor performance of the breed is considered to be the major cause of its population decline. In the present study an attempt has been made to evaluate the production and reproductive performance of Bhadawari buffaloes and to study the effect of non genetic factors on these traits.

MATERIAL AND METHODS

The study was based on data pertaining to Bhadawari buffaloes born and bred at Indian Grassland

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and Fodder Research Institute, Jhansi (UP), India. Jhansi is situated between 25^0.28' N and 78^0 30' E in the Bundelkhand region of India. The region is marked by extremes of temperature, reaching up to 48^0C during the summer months and dropping as low as 1ºC in winter [8]. During summer season, high temperature in the plains creates low-pressure areas that induce movement of the monsoon. The temperature begins to rise in February and peaks in May-June. Hot breezes locally known as *loo* are common during this period. The rainfall distribution pattern is irregular. Approximately 90% of all rainfall in the region caused by the monsoon, falling from June to October. Average annual rainfall is 838.6 to 1251mm, most of which is lost to runoff. July and August are the months of maximum rainfall, while November and April are the driest months of the year [8]. Bhadawari buffaloes purchased from the breeding tract during the year 2001-02 were housed in permanent sheds with open type ventilation and maintained under semi intensive feeding and management. Animals were fed dry roughages (wheat straw, sorghum stover, dry grasses etc) and green fodder (berseem, oat, sorghum, cow pea etc). Concentrate mixture (cereal grains, bran, cakes, mineral mixture and common salt) was provided to all age groups as per the standard requirements. Cows were hand milked twice daily in the morning (4:30 to 5:30 am) and evening (4:30 to 5:30 pm).

Data on production and reproductive performance were collected from the buffaloes maintained under Network Project on Bhadawari buffaloes for the period of 2002 to 2010. The traits studied were peak yield, days to attain peak yield, 305 or less days milk yield, lactation milk yield and lactation length, milk yield per day of lactation, service period, calving interval and dry period. Period and season of calvings were the fixed environmental effects considered for all the traits studied. As the calvings were less in a year, year season analysis was not done. To utilize all available data the entire duration was divided into three periods each with an interval of 3 years assuming that there would not be any major management changes within a period. Each calendar year was sub divided into 3 seasons viz. winter (November to February), summer (March to June) and rainy (July to October).

The data were analyzed using univariate analysis procedure (SPSS- Version 13). The following univariate model was used to study the extent of influence of orthogonalised components attributable to known factors on the traits under study,

$$Y_{ijkl} = \mu + p_i + s_j + o_k + e_{ijkl}$$

Where

Y_{ijkl} is the l^{th} observation pertaining to the trait under focus in the i^{th} period, j^{th} season and k^{th} parity,

μ is over all mean

p_i effect of i^{th} period (i= 1 to 3)

s_j effect of j^{th} season (i= 1 to 3),

ok effect of k^{th} parity (j= 1 to 6),

e_{ijkl} is random errors NID (0, s^2_e)

RESULTS

Production Traits

Least-squares means (±SE) of different production traits are presented in Table **1**. Period of calving had a highly significant (P<0.01) effect on variation of lactation milk yield, lactation length, 305 days milk yield and milk per day of lactation and it had only significant (P<0.05) effect on peak yield and days to attain peak yield. The highest lactation milk yield and 305 days milk yield were observed in period 2 (2005-2007) and they differed significantly from period 1. Lactation length and milk yield per day of lactation were highest in the period 2 and differed significantly from period 1 and 3.

Season of calving had no effect on peak yield, days to attain peak yield and milk yield per day of lactation. However, it had significant (P<0.05) effect on lactation length and a highly significant (P<0.01) effect on lactation milk yield and 305 days milk yield. The lactation milk yield and 305 days milk yield of buffaloes that calved in the winter season was the highest and it differed significantly (P<0.01) with the rainy season calvers. However, there was no significant difference, in the lactation milk yield and 305 day milk yield, between winter and summer season. On the other hand, the lowest lactation milk yield and 305 days milk yield were observed in cows calving in the rainy season. Winter and summer calvers had higher lactation milk yield and 305 days milk yield than the rainy season calvers. The lactation length of the cows that calved in the summer season was the highest and it differed significantly (P<0.05) with the rainy season. However, there was no significant difference, in lactation length between summer and winter season.

Effect of parity was found to be significant on lactation milk yield, 305 days milk yield and milk yield

Table 1: Least Squares Means (±SE) for Different Milk Production Traits of Bhadawari Buffaloes

Effect	N	Peak yield (kg)	Days to attain peak yield	Lactation milk yield (kg)	Lactation length (d)	305 or less days milk yield (kg)	Milk yield /d of lactation (kg)
Overall mean (μ)	206	6.96±0.10	52.8±4.1	1250.5±24.6	291.4±4.9	1213.5±21.6	4.30±0.06
Period		*	*	**	**	**	**
P1	60	6.63±0.18^{a}	39.3±7.1^{a}	1080.6±43.0^{a}	276.8±8.5^{a}	1068.4±37.8^{a}	3.91±0.11^{a}
P2	73	7.02±0.16^{ab}	54.5±6.2^{ab}	1347.7±37.8^{b}	308.5±7.5^{b}	1289.1±33.2^{b}	4.35±0.10^{b}
P3	73	7.24±0.15^{b}	64.5±6.0^{a}	1325.1±36.4^{b}	288.6±7.2^{a}	1283.1±31.9^{b}	4.63±0.09^{c}
Season of calving				**	*	**	
Winter	59	7.22±0.16	48.2±6.2	1321.6±37.5^{a}	296.7±7.4^{a}	1273.2±33.0^{a}	4.46±0.10
Summer	26	6.86±0.24	48.8±9.5	1254.5±57.7^{a}	300.1±11.4^{ab}	1221.1±50.7^{ab}	4.16±0.15
Rainy	121	6.80±0.11	61.4±4.3	1175.3±26.1^{b}	277.2±5.2^{b}	1146.2±22.9^{b}	4.27±0.07
Parity				*		*	*
1st	30	6.64±0.24	65.2±9.3	1231.5±56.3^{ab}	310.6±11.13	1198.9±49.5^{ac}	3.96±0.15^{ab}
2nd	34	7.20±0.22	52.9±8.6	1332.3±52.0^{a}	297.8±10.2	1287.6±45.7^{a}	4.45±0.14^{ab}
3rd	36	7.22±0.22	44.0±8.3	1318.7±50.3^{a}	293.9±9.9	1274.6±44.2^{a}	4.55±0.13^{a}
4th	34	7.25±0.22	55.8±8.6	1270.5±52.1^{a}	286.1±10.3	1224.8±45.8^{ab}	4.44±0.14^{ab}
5th	30	6.81±0.23	56.2±9.2	1227.5±55.5^{ab}	287.5±10.9	1187.7±48.8^{ab}	4.24±0.15^{ab}
6th and above	42	6.63±0.20	42.6±7.7	1122.2±46.9^{b}	272.0±9.2	1107.5±41.2^{bc}	4.13±0.12^{b}

N- number of observations.
*p<0.05; ** p<0.01.
Means bearing same superscript within classes do not differ significantly (p >0.05).

per day of lactation. Highest lactation milk yield (1332.3 kg) and 305 days milk yield (1287.6 kg) was observed in the 2nd parity, however, highest milk yield per day of lactation was observed in the 3rd lactation.

Reproduction Traits

Least squares means (±SE) of different reproductive traits are set out in Table **2**. Analysis of variance revealed that period of calving influenced dry period significantly; however effect on service period and calving interval was not significant. Season of calving influenced service period, calving interval and dry period in a highly significant (P<0.01) manner. Buffaloes calved during the rainy season had significantly (P<0.01) shorter service period, calving intervals and dry periods than those calving in the other seasons. Highest service period, calving interval and dry period were observed in summer season calvers.

Effect of parity was non- significant on all the reproductive traits under study, however, lowest service period was observed in 1st parity and lowest calving interval and dry period were observed in 3rd parity. The reproduction traits did not show any definite trend over the lactations.

DISCUSSION

Lactation milk yield of cattle and buffaloes up to 305 days of lactation is the criterion commonly used for the selection of dairy animals and a study of the performance of this trait is of paramount importance for carrying out selection. The overall 305 days milk yield (1213.5 kg) obtained for buffaloes in this study was comparatively higher than the values reported earlier [9-11] for Bhadawari buffaloes. The overall lactation milk yield of 1250.5 kg in a lactation of 291.4 days was recorded in the present study. A wide variation (693.2 to 1165 kg) in the lactation milk yield and lactation length (284.4 to 320 days) of Bhadawari buffaloes had been reported by several workers. Singh and Desai [12] reported milk yield of 1111 kg for the pooled 300 days lactation. Almost similar milk yield of 1098 to 1165 kg were reported by Singh and Singh [13], Bhat [14], Mishra *et al.* [15], 1092 kg by Singh and Nivsarkar [16], 781 kg by Moioli and Borghese [10] and 1020.43 kg by Sachan *et al.* [11] for in Bhadawari buffaloes. The

Table 2: Least Squares Means (±SE) for Reproductive Traits of Bhadawari Buffaloes

Effect	N	Service period (Days)	N	Calving interval (days)	Dry period (days)
Overall mean (μ)	191	172.4±7.7	176	522.1±12.1	241.80±11.3
Period					**
P1	61	154.4±13.8	56	537.0±19.6	284.0±18.3[a]
P2	63	176.0±11.5	65	508.6±17.5	235.3±16.4[b]
P3	67	186.8±11.2	55	520.5±19.11	206.0±17.8[b]
Season of calving		**		**	**
Winter	39	191.9±13.6[a]	46	526.3±18.8[a]	242.0±17.5[a]
Summer	25	200.8±17.3[a]	20	561.1±28.4[a]	282.1±26.6[a]
Rainy	127	124.4±7.5[b]	110	478.7±12.0[b]	201.1±11.2[b]
Parity					
1st	31	155.4±16.4	27	547.7±25.6	244.1±23.9
2nd	25	171.7±17.8	34	512.7±22.5	236.4±21.1
3rd	32	175.2±15.5	31	478.2±24.6	204.0±23.1
4th	35	166.8±15.2	34	535.0±22.7	260.8±21.2
5th	28	205.3±16.9	23	529.8±28.5	250.7±26.6
6th and above	40	159.9±14.4	27	528.9±25.8	254.7±24.1

N- number of observations.
*P<0.05; ** p<0.01.
Means bearing same superscript within classes do not differ significantly (p >0.05).

lactation milk yield of 693.2 kg in a lactation of 284.4 days reported by Pundir *et al.* [9] was the lowest among the investigations on this breed. The lactation milk yield of 1250.5 kg observed in the present study was comparable with lactation milk yield of 1127.33 kg, 1232.8 kg and 1267.2 kg for Surti buffaloes [17, 18, 19]. Comparatively lower lactation milk yield than those observed in the present study was reported by Tailer *et al.* [20] in Surti buffaloes (1120.9 kg), Tajane and Siddiqui [21] in Mehsana buffaloes (1160.0 kg) and Khire *et al.* [22] in Nagpuri buffaloes (1023.19 kg). However, comparatively higher lactation milk yield ranging from 1400 to 2000 kg was reported for in Murrah, Banni, Nili Ravi, Jaffarabadi, Mehsana, Pandharpuri and Surti (http://www.cirb.res.in). The overall peak yield and days to attain peak yield of 6.96 kg and 52.8 days were obtained in the present investigation. No reports on these traits of Bhadawari buffalo is available in the literature, however, the peak yield observed in the present study was comparatively lower than the peak yields reported with other dairy breeds viz. Murrah, Nili-ravi and Jaffarabadi. The time to reach peak yield obtained in the present study was comparable with the reports of Thiruvenkadam and Panneerselvam [23] for Murrah and Shrinivas *et al.* for Surti buffaloes [18]). Milk yield per day of lactation (4.30 kg) was higher than the values of 2.45 and 3.72 kg reported by Pundir *et al.* [9] and Sachan *et al*. [24], respectively in Bhadawari buffaloes. Differences in the estimates of production traits, reported by various workers, might be due to sampling errors, genetic constitution of the herds, agro-climatic variations and management conditions. In general, the performance in terms of lactation milk yield of Bhadawari buffaloes at Indian Grassland and Fodder Research Institute, Jhansi is higher than the performance reported elsewhere earlier.

The average service period (172.4 days) observed in the present study was lower than the service period reported by Sharma and Singh [25], Pundir *et al.* [9], Nivsarkar *et al.* [26] and Moioli and Borghese [10] for Bhadawari buffaloes . Average calving interval (522.1 days) recorded here was almost similar to the calving interval (524.7 days) reported by Pundir *et al.*, [9] and higher than the reports of Nivsarkar *et al.*, [26] and Moioli and Borghese [10]. Average dry period of 241.80 days observed in the present study was lower than the reported by Moioli and Borghese (2005) and higher than those reported by Nivsarkar *et al.*, [26] in Bhadawari buffaloes. The main factor controlling variations in the calving interval and dry period is the service period, which in turn depends on postpartum oestrus days and number of service per conception. In

addition, many other factors have been implicated in lengthening calving intervals such as embryonic mortality, seasonal and environmental factors, age of cow and sire used for service. The coefficient of variation obtained for the service period in the present study (62%) indicates that the herd was more heterogeneous for this trait. This strongly suggests better opportunities for improvement through good breeding practices. Hence every effort should be made to reduce the service period sufficiently to reduce the calving interval.

The highly significant influence of period of calving observed in the present study on different production and reproduction traits was supported by similar findings on Bhadawari buffaloes (Pundir *et al.* [9] and Murrah buffaloes [27-30] maintained at different places in India. The differences in performance of the animals among different periods, might be attributed to differences in management practices, sires used for breeding, environmental conditions such as ambient temperature, humidity, rainfall etc, and variation in feed and fodder availability.

The significant to highly significant effect of season of calving on different production traits corroborate the findings of earlier workers in Murrah buffaloes [23, 30, 31,] and indicate that there was a pronounced seasonal influence on the traits under study. Buffaloes calving in the winter and summer season had longer lactation lengths and higher lactation milk yields than those calving in rainy season. This confirms the findings of earlier reports of Dass and Sadana [31] and Gogoi *et al.* [37] for Murrah buffaloes. The higher lactation milk yield in winter and summer season calvers may be due to less gestational stress and an abundant availability of fodder in monsoon season coinciding with the lactation period.

The highly significant effect of season of calving on service period and calving interval are in agreement with earlier findings of Sharma and Singh [25] for Bhadawari, Chhikara *et al.* [33], Suresh *et al.* [28] for Murrah, Zulfiqar Hussain [34] and Hassan *et al.* [35] for Nili Ravi buffaloes in Pakistan. Anonymous [36] also reported the main calving period between July to December for Murrah, Pandharpuri, Jaffrabadi and Surti buffaloes in Haryana, Maharashtra, Gujrat and Rajasthan states respectively. Sule *et al.* [37] confirmed a distinct seasonality in breeding behavior in Surti buffaloes reared in Rajasthan. The monthly and seasonal calving pattern of Surti buffaloes indicated that buffaloes calved round the year but have a tendency to calve more during rainy season (July to September) followed by winter season (October to January). The rainy period and the winter period appeared the most favourable season while the summer appeared to be the most unfavourable season for buffalo reproduction. Reddy *et al*. [38] also reported that August to November was the most favourable period for reproduction in Murrah buffaloes. Agrawal [39] reported that a determining factor in production and reproduction of farm animals all over the world is environment. Season affects the breeding efficiency, buffaloes have tendency to performance better during the cool months; 70 - 80 % of calving in buffaloes occurs between July and January. Misra and Sengupta [40] reported that in India, the buffalo's sexual vigour declines during summer and improves with the onset of the colder season.

CONCLUSION

In general, milk production of the Bhadawari buffaloes in the herd under study was comparatively better than the performance of Bhadawari buffaloes reported in the literature. Lactation performance of Bhadawari buffaloes was comparable or better than most of the buffalo breeds except the larger buffalo breeds viz. Murrah, Nili-Raviand and Jaffarabadi. Non genetic factors such as period and season of calving had a significant effect on most of the traits under study. Large coefficient of variation observed for different traits indicates that there is an enough scope for improvement in the production and reproduction performance. Temporary environmental factors play a major role on the fitness traits (reproduction traits), better breeding management is needed for improvement. It is therefore imperative to emphasize improvement in husbandry practices and introduction of genetic evaluation and improvement programs at the same time.

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