Factors Affecting Performance of Indian Murrah Buffalo: A Review

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Abstract: Murrah is one of the best buffalo breed in India. The success of Indian dairy industry is much dependent on productivity and efficient reproduction performance of Murrah buffaloes. The environmental factors are generally influenced the Murrahs' performance as well as other breeds. The performance traits reviewed were first lactation 305-days or less milk yield, first lactation length, first lactation average daily milk yield, dry period, growth, age at first calving, first service period, calving interval, age at maturity, age at calving, days to first service, number of services per conception, breeding interval, breeding efficiency, conception rate and daughter pregnancy rate of Murrah buffalo. All the productive and reproductive traits were affected by herd, year and season of calving.

Keywords: Age at first calving, breeding efficiency, environmental factors, first service period Murrah buffalo.

INTRODUCTION

The buffalo is multipurpose animal in Indian sub-continent. It is not only a better source of milk but also provides meat and works as a draught animal in India. Of all the buffaloes available in the world, the Murrah buffalo holds the greatest promise and potential for milk production. It is well known that the buffalo is also remarkable for its feed conversion ability. Since, the animal breeder selects individual animal based on performance, therefore it is imperative to improve economically important characters of animals simultaneously to increase the profitability in dairying. The dairy sector in India has shown remarkable development in the past decade. Buffaloes play pivotal role in Indian livestock industry, contributing 17% in world milk production and 48% in Asia [1]. India has the largest buffalo population of the world, about 105.34 million [2] and their numbers are increasing continuously. The success of Indian dairy industry is much dependent on productivity and efficient reproduction performance of Murrah buffaloes. In order to enhance productivity of a dairy animal, it is necessary to develop an understanding of the factors affecting its milk production. Milk yield and lactation length, two important parameters in dairy animals, depend on both genetic and non-genetic factors. Genetic improvement may be brought about by selection.

The non-genetic factors such as management, amount and quality of feed, season etc. also influence milk yield and lactation length, and need to be assessed in a production set up. The genetic improvement of growth of Murrah buffaloes is of great importance in the large ruminant industry in India, since buffaloes contribute 19.8% of the total meat production [3]. Reports on growth rate of Murrah buffaloes were few [4-8] and little is known about the non-genetic factors that can interfere with body weight at different ages in Murrah buffaloes. Under this background, this review aimed to evaluate effects of various non-genetic factors on performance of Murrah buffaloes. This will help to formulate suitable evaluation procedures especially in organised farms for improving economic traits of this breed.

FIRST LACTATION 305-DAYS OR LESS MILK YIELD

The average first lactation 305-days or less milk yield (305 MY) in Murrah buffaloes ranged from 1355.4 ± 18.96 kg [9] to 1964.00 ± 38.6 kg [10]. The overall least-squares mean for first lactation 305-days or less milk yield was estimated as 1846.86 ± 35.92 kg in Murrah buffalo [11]. The average 305 MY was found as 1750.91 ± 28.62 kg [12]. The effect of season of calving on 305 MY reported significant [13-16] and non-significant [17-23]. Reports available showed significant effect of period of calving on 305 MY [10,13-16, 19-26]. The effect of herd on 305 MY reported significant [27].

FIRST LACTATION LENGTH

The first lactation length (FLL) in Murrah buffaloes ranged from 278.26 ± 3.19 days [28] to 373.10 ± 5.80 days [9]. Valsalan *et al.* [29] reported lactation length 286.06 ± 1.72 days in Murrah buffaloes. The effect of season of calving on FLL reported significant [16] and non-significant [18, 19, 20, 30, 23]. Reports available showed significant effect [16, 19, 20, 23, 30,] and non-significant effect [31] of period of calving on FLL.

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FIRST LACTATION AVERAGE DAILY MILK YIELD

The trait is important to know the milk producing capacity of animal. The range of the average milk yield per day of first lactation length was 3.73 ± 0.86 [17] to 8.60 kg/day [32]. The overall least-squares mean for first lactation average daily milk yield was estimated as 6.34 ± 0.10 kg in Murrah buffalo [33] Significant effect of period of calving on first lactation average daily milk yield was observed [15-18] while non-significant effect was observed by Khosla *et al*. [32] and Shabade *et al*. [31]. Significant effect of season of calving on first lactation average daily milk yield was observed [13, 15, 16] while non-significant effect was observed by Sharma [17] and Singh and Yadav [34]. The effect of herd on average daily milk yield reported significant [27].

DRY PERIOD

Dry period (DP) is an important economic trait which has the direct effect on lifetime milk production. There is a lot of variability observed in the dry period in Murrah buffaloes. Nath [16] reported the average first dry period in Murrah buffaloes was minimum (137 days). Significant effect of period on FDP observed by many workers [10, 16, 18, 19, 35-39] while, non-significant effect of period on FDP observed by Dass [20]. The significant effect of season of calving on FDP was reported by many workers [10, 16, 20, 37-40] while, non-significant effect of season of calving was observed by Sahana [18] and Dhara [19]. Basu and Ghai [41] reported that the summer calvers had the least FDP whereas, buffaloes in other seasons had longer first dry period. Nath [16] observed that buffaloes which calved in rainy season had minimum first dry period. Gupta *et al*. [42] estimated DP as 207.56±7.63, 174.34±8.02 and 171.91±9.77 days for first, second and third parity, respectively in Murrah buffaloes. On the other hand, Gogoi *et al.* [43] estimated DP as 158.20±5.01, 143.03± 52.2, 135.85±6.34 and 110.66±6.62 days for first, second, third and fourth parity, respectively in Murrah buffaloes. Suresh *et al*. [38] also estimated DP as 189.15±8.39, 193.36±9.24, 189.37±10.35 and 190.77±12.46 days for first, second, third and fourth parity, respectively in Murrah buffaloes.

GROWTH

The genetic improvement of growth of Murrah buffaloes is of great importance in the large ruminant industry in India, since buffaloes contribute 19.8% of the total meat production [3]. In addition, the growth rate of a heifer calf until it matures to a cow is also an important trait because it characterises the adaptability and economic suitability of the animal. It is expected that animals growing faster in terms of body weight may also initiate physiological functioning of reproduction and milk production earlier. Thiruvenkadan *et al.* [44] found adjusted birth weights of male and female calves 33.0 ± 0.49 and 31.9 ± 0.27 kg, respectively, with an overall value of 32.4 ± 0.30 kg. The mean body weight at three, six, nine and 12 months of age pooled over periods, season and sex were 62.0 ± 0.65, 87.9 ± 0.95, 112.4 ± 1.23 and 134.16 ± 1.41 kg, respectively. Period of calving influenced the weight significantly at birth, three and six months of ages only. The effect of dam parity on body weight at different ages was highly significant. The calves born during the dam's second parity were generally heavier than those born in other parities.

AGE AT FIRST CALVING

Age at calving is an important trait because lower age at first calving (AFC) leads to shorter generation interval and hence increases genetic gain. Reports available in literature indicated that least-squares means for AFC in Murrah buffaloes ranged from 1216.64±17.03 days [45] to 1656.87±31.26 days [35]. The least-squares mean for age at first calving was estimated as 43.69 ±0.46 months for Murrah buffaloes [27]. Significant differences in AFC due to period of birth was reported by many workers [16-20, 35, 37, 40, 45-48,]. On the other hand significant effect of season of birth on AFC was reported by many workers [18, 37, 40, 45, 48] where as non significant effect of season of birth was also observed [16, 17, 19, 20, 35, 47, 46]. Gogoi *et al*. [45] found that winter calvers had significantly lower AFC followed by rainy and summer calvers in Murrah buffaloes. The effect of herd on AFC reported significant [27].

FIRST SERVICE PERIOD

The literature available indicated that the average first service period in Murrah buffaloes ranged from 143.41 ± 3.97 [16] to 281.50 ± 8.65 days [49]. Patil *et al.* [50] found FSP 161.65 ± 4.61 in Murrah buffaloes. Significant effect of period of first calving on FSP was found by many workers [16, 19, 21, 35, 36, 38, 39, 51]. Suresh *et al.* [38] and Chakraborty [39] reported significant effect of season of calving on FSP while, non-significant effect of season of calving on FSP was reported by many workers [19, 35, 51]. El-Arian [13]

observed significantly longer FSP in autumn and winter calvers in Egyptian buffaloes. Swain and Bhatnagar [52] observed service period as 148.00±8.9, 144.80±8.8, 167.40±3.9 and 134.10±3.40 days for first, second, third and fourth parity, respectively. Gupta *et al*. [48] reported that service period for first, second and third parity as 232.09±10.37, 185.90±10.83 and 179.38±12.91 days, respectively in Murrah buffaloes with significant effect of parity on service period. Nath [16] reported higher FSP for spring calvers in Murrah buffaloes. The effect of herd on FSP reported significant [27].

CALVING INTERVAL

The interval between two successive calvings referred to as calving interval (CI) which is consist of two components - service period and gestation period. Among the traits of dairy animals calving interval is the most important trait as it determines the number of lactations possible in the life time of an animal thereby influences its production of an animal. First calving interval (FCI) in Murrah buffaloes is one of the important reproductive trait reported by many workers. There is a lot of variability observed in the FCI in Murrah buffaloes. Prakash *et al*. [53] reported the average FCI in Murrah buffaloes was minimum (437 days) whereas the highest average of the same trait was 632 days reported by Sharma and Singh [9]. Haipeng and Runpei [54] reported average calving interval as 444.1±15.8 days in Nili-Ravi buffaloes. Singh *et al.* [55] reported average calving interval (CI) for first, second and third parity as 464.6, 435.1 and 432.6 days, respectively. Duran *et al*. [56] reported calving interval of 15.5±4.51 months in Murrah buffaloes.

The literature reviewed indicated that the first calving interval (FCI) in Murrah buffaloes ranged from 415.97±8.26 days [57] to 636.00±32.83 days [51]. Significant effect of period of calving on FCI reported by many workers [18, 19, 20, 16, 35, 37-40, 58,] while, non-significant effect of period on the same trait reported by Yadav and Rathi [51] and Chourasia *et al.* [59]. Significant influence of season of calving on FCI was reported by many workers [18, 20, 37-40, 51, 58] whereas, non-significant effect of season was observed by many workers [18] observed that buffaloes which calved during rainy season had significantly shorter calving interval. Gupta *et al.* [48] estimated CI as 519.79±13.46, 482.31±14.76 and 475.12±20.15 days for first, second and third parity, respectively in Murrah buffaloes. Swain and Bhatnagar [52] also estimated the CI as 455.10±9.3, 455.6±9.10, 477.50±8.4 and 447.8±8.3 days for first, second, third and fourth parity, respectively in Murrah buffaloes. Suresh *et al.* [38] reported CI as 496.33±10.87, 519.21±11.97, 487.38±16.14 and 478.00±16.14 days for first, second, third and fourth parity, respectively in Murrah buffaloes.

AGE AT MATURITY

The age at maturity (AAM) is an indication that an animal has attained adult life. The onset of first heat in Egyptian heifers estimated by El-Itriby [60] and Taha [61], as 405-630 and 670.5 ± 15.23 days, respectively. Naz and Ahmed [62] reported the AAM as 1166 ± 15.60 days in Nili-Ravi buffaloes.

Sattar *et al.* [63] reported highest as well as lowest least-squares means of age at maturity (AAM) estimated as 628.22 ± 12.29 and 586.57 ± 26.43 days in heifers born during humid hot and dry hot seasons, respectively in Jersey cows. They observed non-significant effect of season on age at maturity. Sattar *et al.* [64] also reported highest and lowest least-squares means of AAM as 674.67 ± 16.08 and 638.09 ± 14.07 days in heifers born during humid hot and winter seasons, respectively in Holstein-Freisian cows. They also reported non-significant effect of season on age at maturity.

DAYS TO FIRST SERVICE OR WAITING PERIOD

Waiting Period (WP) or Days to First Service (DFS) is one of the important reproduction traits. WP or DFS is the initial phase of lactation during which no inseminations occur. The lower the WP or DFS shows higher the breeding efficiency in dairy animals. The literature on WP or DFS in Murrah buffaloes is scanty, however Patil [65] reported that Postpartum oestrous is about 107.98±2.69 days in Murrah buffaloes. Nawale [66] reported that average days to first service was 122.10±4.58 days in Murrah buffaloes. Reducing WP is tempting because of associated reductions in calving interval.

NUMBER OF SERVICES PER CONCEPTION

Kadu *et al.* [67] reported number of services per conception (NS/C) was 1.31±0.23 in Nagpuri buffaloes. However, in Murrah buffaloes, Gupta *et al.* [48] reported average NS/C was 1.49 ± 0.06, 1.17 ± 0.03 and 1.32±0.06 for first, second and third parity, respectively. Least-squares means of NS/C was 1.92±0.75 [68]. Average number of services per conception in buffaloes ranges from 1.5 to 2.0 in India

[69]. The NS/C in Egyptian buffaloes reported as 1.51 [70].

Reports available in literature indicated that least-squares means for number of services per conception (NS/C) in Murrah buffaloes ranged from 1.73±0.00 [71] to 3.74±0.26 days [49]. Significant effect of period of birth on NS/C reported by Vij and Tiwana [47] whereas, non-significant effect of period of birth observed by Basu *et al.* [72] and Yadav and Rathi [51]. Significant effect of season of birth on NS/C found by Yadav and Rathi [51] whereas non-significant effect of season reported by many workers [47,72]. Abhi *et al*. [73] observed the number of NS/C as 3.1-4.5 in Murrah buffaloes with highest observed in May-July having the highest duration of sunlight. In Murrah buffaloes NS/C was estimated as 1.60 [74], 3.74±0.26 [49] and 1.81±0.24 [57]. Cady *et al*. [75] estimated NS/C as 1.66±0.05, 1.65±0.05, 1.62±0.05 and 1.74±0.06 in first, second, third and fourth parity, respectively in Nili-Ravi buffaloes with significant effect of period on number of services per conception. Basu *et al*. [72] reported highest NS/C (2.24±0.15) in summer season while, least value of NS/C (1.88±0.16) in autumn season in Murrah buffaloes.

BREEDING INTERVAL

The literature on estimated breeding interval (BI) in buffaloes is not available however, the breeding interval on European cows were estimated by various workers in different ways. Norman *et al.* [76] reported the breeding interval increased from 51 to 69 days for Holstein cows and 44 to 55 for Jersey cows from 1996 to 2006. Swain and Bhatnagar [52] obtained Post-Partum Breeding Interval (PPBI) as 87.36±3.66 days in Murrah buffaloes. Swain and Bhatnagar [52] also reported PPBI as 107.70±5.7, 102.10±5.6, 113.50±5.00 and 87.50±5.1 days for first, second, third and fourth parity, respectively.

Significant effect of period and season of first calving on breeding interval was found by [52] in Murrah buffaloes. Non-significant effect of season reported by Bhalla *et al.* [77] and Hussain *et al*. [78] on PPBI in Nili-Ravi buffaloes. Singh and Lal [79] observed least-squares mean of PPBI (7.6 ± 0.23 months) which were lowest for buffaloes calving in summer and monsoon seasons.

BREEDING EFFICIENCY

A buffalo producing a calf every year shows an ideal breeding efficiency. The breeding efficiency (BE) is also an indication of reproductive efficiency. The literature reviewed, as presented in, indicated that the least-squares means for BE in Murrah buffaloes ranged from 54.32±1.70 % [80] to 83.88 % [81]. Significant effect of period of calving on BE reported by Sharma and Singh [9] while, non-significant effect of period on the BE reported by Chourasia *et al.* [59]. Significant influence of season of calving on BE was reported by Charyulu and Prabhu [82] and Dutt and Yadav [57], whereas, non-significant effect of season on BE observed by Chourasia *et al*. [80] and Sharma and Singh [9]. Charyulu and Prabhu [81] estimated the breeding efficiency of buffaloes by Wilcox method and observed that breeding efficiency ranges from 84% to 98%. Juma *et al*. [83] reported that the least-squares mean for breeding efficiency varies between 81 to 90% among Iraqi buffaloes.

CONCEPTION RATE

The least-squares means of conception rate (CR) in Murrah buffaloes was estimated as 33.19% [84]. Sarkar *et al*. [84] reported that period had significant effect on conception rate in Murrah buffaloes. Pasha *et al*. [85] reported CR as 47.07, 41.51, 39.81 and 51.96 % in winter, spring, summer and autumn, respectively in Nili-Ravi buffaloes with significant effect of season on conception rate.

DAUGHTER PREGNANCY RATE

In February, 2003, USDA introduced National genetic evaluations for cow fertility. These evaluations, reported as daughter pregnancy rate (DPR), are based on days open. An animal model was developed for routine genetic evaluations of US dairy cattle. Pregnancy rates calculated by USDA's Animal Improvement Programs Laboratory are often somewhat higher than those reported by dairy records processing centres and reproductive specialists [86]. Pregnancy rate calculations are more current, cows that do not become pregnant are included in calculations more easily, and larger rather than smaller values are desirable. The pregnancy rate is 20% for a herd that averages 154 days open as compared to 25% for a herd with 133 days open. Improvements in DPR will pay off economically. A genetic evaluation tool for reproduction now exists in the form of Daughter Pregnancy Rate. DPR is calculated from days open and is directly related to the proportion of females eligible to become pregnant in a 21-day period that actually become pregnant (i.e. the 21-day pregnancy rate). In a study by Patil [65] it was found that DPR of

Murrah buffaloes varied from 0.31 to 0.35 based on a minimum of 42 and above to 105 and above waiting period or days to first service.

CONCLUSION

Murrah is one of the seventeen documented buffalo breeds of India that has gained international recognition but the productivity of Murrah buffalo has been reported to vary within countries. The variations in performance traits may be more of environmental nature as opposed to genetics; sampling of population and data edits might have widened these ranges. For other reproductive traits, reports disagree even to a great extent. Parity, Herd, year and season of calving affected most of the performance traits in Murrah buffalo. Herd variations represent managemental differences for most of the traits. It was also noted that buffaloes calving in winter season produced higher milk yield as compared to those calving in summer season due to more availability of fodder and comfortable temperature than in summer. The age at first calving in Murrah was affected by herd, year and season of birth. However, most of the herd differences on age at first calving were reported by only those studies using multiple herd records of Murrah breed.

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