The Pharma Innovation Journal 2023; 12(5): 3893-3837

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 3893-3897

www.thepharmajournal.com
Received: 02-03-2023
Accepted: 09-04-2023

Smriti Sharma
Department of Animal Genetics and Breeding, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Jigyasha
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Lalmuansangi
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Sahana VN
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Chandana Sree Chinnareddyvari
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Akshata Patil
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Shivam Bhardwaj
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Anil
Department of AHVS, Karnataka, India

Corresponding Author:
Jigyasha
Animal Genetics and Breeding Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Influence of non-genetic on production performance traits in Murrah buffaloes: A review

Smriti Sharma, Jigyasha, Lalmuansangi, Sahana VN, Chandana Sree Chinnareddyvari, Akshata Patil, Shivam Bhardwaj and Anil

Abstract
Murrah buffaloes are the cynosure of milch buffalo breed in India having the potential for high milk production and widely used for the up gradation of the local and non-descript animals. Genetic worth is determined by the production efficiency of the animals and due to this, these traits has been a primary part of all breeding strategies conducted for improvement in dairy animals. Apart from this, these production performance traits *viz.* 305 days milk yield (305 DMY), peak yield (PY), lactation length (LL), dry period (DP), lactation milk yield (LMY), wet average (WA), milk yield per day of calving interval (MCI) and milk yield per day at age at second calving (MSC) are under the influence of non-genetic factors like period of calving, season of calving and parity of the animals. Adjustment for these non-genetic factors is necessary for accurate estimation of genetic parameters. Consideration of environmental influence directs the selection process accordingly and aids in breeding strategy of the herd.

Keywords: Murrah buffaloes, genetic parameters, non-genetic factors, production performance traits

Introduction
Buffaloes are considered as the major backbone for dairy and it contributes to huge milk production in India producing more than 50% of milk production of our country. The total milk production in India during 2021-22 was 221.06 million (BAHS, 2022) [2] with an annual growth rate of 5.29%. among all the buffalo breeds, Murrah breed of buffalo holds a predominant position in term of its production efficiency and maintaining its world class position in milk production. This breed mainly resides in Haryana and the adjoining states of Punjab, UP and Delhi. Production performance of animals is a determinant factor for its economic worth. Genetic parameters along with the influence of non-genetic factors aids in improving the worth of animals in a herd and direct the animal breeders towards the selection of appropriate breeding plan for their farm. The ongoing breeding goals are mainly focused on the production efficiency of the animals, thus considering this in view, production performance traits *viz.* 305 days milk yield (305 DMY), peak yield (PY), lactation length (LL), dry period (DP), lactation milk yield (LMY), wet average (WA), milk yield per day of calving interval (MCI) and milk yield per day at age at second calving (MSC) were taken into consideration for this review. Along with this, the non-genetic factors like period of calving, season of calving and parity had a influential impact on the production performance traits. Under this background, this review was aimed to evaluate the influence of non-genetic factors on the production performance traits in Murrah buffaloes.

Production performance traits
Averages and factors affecting production performance traits
The reports of earlier researchers depicted in table 1 for prior estimated values of production performance traits *viz.*, 305 days milk yield (305 DMY), peak yield (PY), lactation length (LL), dry period (DP), lactation milk yield (LMY), wet average (WA), milk yield per day of calving interval (MCI) and milk yield per day at age at second calving (MSC) varied from 1686.20 kg (Thiruvenkadan, 2011) [45] to 2258.17 kg (Kaur *et al.*, 2020) [24]; 8.87 kg/day (Thiruvenkadan *et al.*, 2014) [46] to 13.17 kg/day (Kaur *et al.*, 2020) [24]; 267.15±8.52 (Suresh *et al.*, 2004) [42] to 340.48 days (Kaur *et al.*, 2020) [24]; 121.68 days (Jamal *et al.*, 2018) [20] to 250.50 days (Thiruvenkadan *et al.*, 2010) [47]; 1686.20 kg (Thiruvenkadan *et al.*, 2010) [47] to 2465.48 days (Kaur *et al.*, 2020) [24]; 6.34 kg/day (Kumar *et al.*, 2014) [28] to 7.29 kg/day (Jamuna *et al.*, 2015a) [21]; 3.20 kg /day (Suresh *et al.*, 2004) [42] to 4.40 kg/day (Patil *et al.*,

2018) [33] and 1.00 kg/day (Chakraborty *et al.*, 2010b) [8] to 1.08 kg/day (Patil *et al.*, 2018) [33].

Effect of period of calving on production performance traits

Pathodiya and Jain (2004) [32]; Sarkar *et al.* (2006) [37]; Wakchaure (2008) [49]; Gupta *et al.* (2012) [17] and Jamuna *et al.* (2015b) [22], reported that 305 days or less milk yield (305DMY) was significantly (p<0.05) influenced by the period of calving in Murrah buffaloes. Similar results for significant (p<0.01) effect of period of calving on 305 DMY was reported by Suresh *et al.* (2004) [42]; Thiruvenkadan *et al.* (2010) [47]; Pawar *et al.* (2012) [34]; Chaudhari (2015) [10] and Singh *et al.* (2012) [40]. Likewise, Jakhar *et al.* (2016) [19] obtained significant (p<0.05) effect of period of calving on LMY, 305DMY and PY. However, Barman *et al.* (2012) [4], Pawar *et al.* (2012) [34] and Kumar *et al.* (2014) [28] reported non-significant effect of period of calving on LMY in Murrah buffaloes. Prakash and Tripathi (1987) [35] reported no effect of period on PY in Murrah buffaloes and Aziz *et al.* (2001) [1] reported non-significant effects of period of calving on LL in buffaloes. Significant (p<0.01) effect of period of calving on dry period (DP) was reported by Jamal *et al.* (2018) [20], similar results were reported by Lathwal (2000) [29] and Sidgel *et al.* (2014) [39]. Contrarily, Jamuna *et al.* (2015b) [22] found non-significant effect of period of calving on lactation length (LL). Suresh *et al.* (2004) [42] and Thiruvenkadan (2011) [45] reported significant influence of period of calving on MCI in Murrah buffaloes whereas Chakraborty *et al.* (2010b) [8] and Chaudhari (2015) [10] found non-significant effect of period of calving on MCI. In addition to this, Chakraborty *et al.* (2010b) [8] also reported significant effect of period of calving on MSC.

Effect of season of calving on production performance traits: According to Catillo *et al.* (2001) [6], season of calving has a mild effect on MY and LL. Kumar *et al.* (2014) [28] and Jakhar *et al.* (2016) [19] reported that the season of calving showed non-significant effect on 305DMY which was in accordance with the findings of Singh *et al.* (2011) [41] in Nili-Ravi breed while contrary reports were reported by Dass and Sadana (2000) [13]; Thiruvenkadan *et al.* (2010) [47]; Pawar *et al.* (2012) [34] and Chaudhari (2015) [10] in Murrah buffaloes. Thiruvenkadan *et al.* (2010) [47]; Chaudhari (2015) [10] and Kaur *et al*. 2020 reported significant (p<0.05) effect of season on PY. Jakhar *et al.* (2016) [19] found significant effect of season of calving on LL and DP. Similar findings were reported by and Wakchaure *et al.* (2008) [49]. Likewise, Jamal *et al.* (2018) [20] reported significant (p<0.05) effect on dry period. Similar results were reported by Dass and Sadana (2000) [13], Lathwal (2000) [29], Kumar *et al.* (2000) [26], Suresh *et al.* (2004) [42] and Sidgel *et al.* (2014) [39]. In addition to this, Pawar *et al.* (2012) [34]; Chaudhari (2015) [10] and reported highly significant (p<0.01) effect of season of calving on LMY in Murrah buffaloes. A significant effect of season of calving was also reported by Barman (2009) [3] and Barman *et al.* (2012) [4] in Murrah buffaloes. However, Suresh *et al.* (2004) [42] and Kumar *et al.* (2014) [28] reported non-significant effect of season of calving on LMY in Murrah buffaloes. Significant effect of season of calving on MCI was reported by Kumar (2000) [26], Dass and Sadana (2000) [13], Godara (2003) [16], Suresh *et al.* (2004) [42] and Thiruvenkadan (2011) [45] however, Chaudhari (2015) [10] reported contrary to it. Also, significant (p<0.05) effect of season of calving on MSC was reported by Deshpande *et al.* (1992) [14] and Tekerli and Gundgaon (2005) [44]. Contrarily, Chakraborty *et al.* (2010b) [8] in Murrah buffaloes reported non- significant effect of season of calving on MCI and MSC.

Effect of parity on production performance traits

Catillo *et al.* (2001) [6] reported that the calving order (parity) has a positive effect on milk yield especially because older cows produce more milk in shorter lactations. Jakhar *et al.* (2016) [19] and Kaur *et al.* (2020) [24] reported significant effect of parity on 305 DMY, PY and LL. Buffaloes were found to attain peak average production (10.13 kg) during second stage of lactation (Kaur *et al.*, 2020) [24]. Jamuna *et al.* (2015b) [22] reported significant effect of parity on LL. Parity had non-significant influence on dry period as found by Chaudhari (2015) [10] and Jamal *et al.* (2018) [20]. In other research studies, Lathwal (2000) [29], Jakhar *et al.* (2016) [19] recorded significant effect of parity on DP and LMY whereas Kaur *et al.* (2020) [24] reported non-significant effect of parity on LMY. Dhar and Deshpande (1992) [14], Dass and Sadana (2000) [13], Thiruvenkadan (2011) [45] and Chaudhari (2015) [10] reported significant (p<0.05) effect of parity on LMY, PY, WA and MCI in Murrah buffaloes. Hussain *et al.* (2006) [18], Thiruvenkadan (2011) [45] Chaudhari (2015) [10] and Jamuna *et al.* (2015b) [22] reported significant effect of parity on 305DMY and LL in Murrah buffaloes. However, Singh *et al.* (2011) [41] and Pawar *et al.* (2012) [34] reported non-significant effect of parity on LMY in Nili-Ravi and Murrah buffaloes, respectively. A non-significant effect of parity on PY was obtained by Chowdhary and Chowdhary (1981) [11] in Mehsana buffaloes. A non-significant effect of parity on LL was reported by Bharat *et al.* (2004) [5] and Thiruvenkadan (2011) [45] in light breed of buffaloes and Murrah buffaloes, respectively. Dass and Sadana (2000) [13] and Thiruvenkadan (2011) [45] reported highly significant ($p \leq 0.01$) effect of parity on MCI in Murrah. Suresh *et al.* (2004) [42] and Chaudhari (2015) [10] reported non-significant effect of parity on MCI in Murrah buffaloes.

Table 1: Least square mean and heritability estimates of production performance traits

Production Traits			
305 Days Milk Yield (kg)			
No. of obs.	**Means ± SE**	**h^2±S.E**	**Reference**
326	1937.88±28.56	0.29±0.25	Chakraborty *et al.* (2010a) [7]
395	1686.20± 44.40	---------	Thiruvenkadan (2011) [45]
330	1942.75± 53.79	---------	Gupta *et al.* (2012) [17]
1213	1761.57±506.91	0.28±0.08	Singh and Barwal (2012) [40]
515	2229.87± 93.70	----------	Pawar *et al.* (2012) [34]
832	2034±47.97	----------	Kumar *et al.* (2014) [38]
435	----------	0.20±0.18	Pareek and Narang (2014) [30]

479	2086.17±44.66	0.39±0.14	Dev *et al.* (2015) [15]
522	2078.20±31.26	0.15±0.03	Jamuna *et al.* (2015a) [21]
1637	2060.93± 20.22	0.50± 0.08	Jakhar *et al.* (2016) [19]
----	1758±31	0.18±0.08	Singh *et al.* (2016) [51]
536	2041.27 ± 32.78	0.26±0.18	Patil *et al.* (2018) [33]
445	2258.17 ± 95.73	-	Kaur *et al.* (2020) [24]
Peak Yield (kg/day)			
506	---------	0.24±0.13	Chander (2002) [9]
326	10.16±0.26	0.19±0.11	Chakraborty *et al.* (2010a) [7]
1479	10.50±0.30	----------	Singh *et al.* (2011) [41] Nili-Ravi
395	9.09±0.07	----------	Thiruvenkadan (2011) [45]
--	12.11±0.27	----------	Tanpure *et al.* (2013) [43]
435	---------	0.48±0.17	Pareek and Narang (2014) [30]
1980	8.87±0.05	---------	Thiruvenkadan *et al.* (2014) [46]
479	9.96±0.11	0.37±0.13	Dev *et al.* (2015) [15]
1637	10.08± 0.96	0.52± 0.08	Jakhar *et al.* (2016) [19]
536	10.55±0.25	0.24±0.17	Patil *et al.* (2018) [33]
-	11.13±0.44	-	Kumar *et al.* (2017) [25]
445	13.17±0.45	-	Kaur *et al.* (2020) [24]
Lactation Length (days)			
1003	303.74± 5.92	---	Yadav *et al.* (2002) [50]
	267.15±8.52	---	Suresh *et al.* (2004) [42]
	269.69±4.87	0.23±0.14	Sachan *et al.* (2006) [36]
441	323.62± 3.73	---	Katneni (2007) [23]
1200	321.21± 2.25	0.09±0.07	Wakchaure *et al*, (2008) [49]
628	326.13± 6.70	---	Gupta (2009) [52]
698	312.8± 5.7	0.10±0.10	Thiruvenkadan *et al.* (2010) [47]
113	313.16± 0.43	---	Pandey *et al.* (2015) [53]
522	286.08±2.23	-	Jamuna *et al.* (2015a) [21]
1637	311.68 ±3.35	0.36± 0.09	Jakhar *et al.* (2016) [19]
445	340.48±14.14	-	Kaur *et al.* (2020) [24]
Dry Period (days)			
1200	164.18± 4.70	---	Wakchaure *et al.* (2008) [49]
698	250.5± 15.9	0.19 ±0.13	Thiruvenkadan *et el.* (2010) [47]
1637	173.34± 5.59	0.23± 0.07	Jakhar *et al.* (2016) [19]
742	121.68± 1.39	---	Jamal *et al.* (2018) [20]
Lactation Milk Yield (kg)			
698	1686.2± 44.4	0.14± 0.10	Thiruvenkadan *et al.* (2010) [47]
435	---	0.23 ±0.18	Pareek and Narang (2014) [30]
698	1855.6± 16.1	---	Thiruvenkadan *et al.* (2014) [46]
832	2034.88 ±47.97	---	Kumar *et al.* (2014) [28]
1637	2182.82±20.19	0.47±0.08	Jakhar *et al.* (2016) [19]
176	2253.88± 70.15	---	Verma *et al.* (2017) [48]
445	2465.48±130.72	-	Kaur *et al.* (2020) [24]
Wet Average (kg/day)			
560	6.09±0.03	0.36±0.20	Godara (2003) [16]
624	5.33±0.12	-	Suresh *et al.* (2004) [42]
326	6.09±0.07	0.19±0.23	Chakraborty *et al.* (2010b) [8]
462	6.80±0.20	0.22±0.08	Singh and Barwal (2012) [40]
1980	6.16±0.04	-	Thiruvenkadan *et al.* (2014) [46]
832	6.34 ±0.10	---	Kumar *et al.* (2014) [28]
522	7.29± 0.06	0.17±0.4	Jamuna *et al.* (2015b) [21]
479	6.85±0.90	0.36±0.12	Dev *et al.* (2015) [18]
7870	7.00 ±0.22	0.34± 0.03	Parmar *et al.* (2019) [31] Mehsana buffaloes
Milk Yield Per Day of Calving Interval (kg/day)			
1214	3.65±0.07	0.20±0.07	Kumar *et al.* (2000) [26]
560	4.00±0.03	0.26±0.15	Godara (2003) [16]
624	3.20±0.13	----------	Suresh *et al.* (2004) [42]
326	3.98±0.06	0.26±0.18	Chakraborty *et al.* (2010b) [8]
536	4.40±0.07	0.30±0.21	Patil *et al.* (2018) [33]
Milk Yield Per Day of Age at 2nd Calving (kg/day)			
326	1.00±0.02	0.27±0.19	Chakraborty *et al.* (2010b) [8]
536	1.08±0.01	0.28±0.21	Patil *et al.* (2018) [33]

Heritability estimates of production performance traits

Prior heritability estimated values of production performance traits, as shown in table 1 like 305 days milk yield, peak yield, lactation length, dry period, lactation milk yield, wet average, milk yield per day of calving interval and milk yield per day at age at second calving varied from 0.15 (Jamuna *et al.*, 2015a) [21] to 0.50 (Jakhar *et al.*, 2016) [19]; 0.19 (Chakraborty *et al.*, 2010a) [7] to 0.52 (Jakhar *et al.*, 2016) [19]; 0.09±0.07 (Wakchaure, 2008) [19] to 0.36 (Jakhar *et al.*, 2016) [19]; 0.19 (Thiruvenkadan *et al.*, 2010) [47] to 0.23 (Jakhar *et al.*, 2016) [19]; 0.14 (Thiruvenkadan *et al.*, 2010) [47] to 0.47 (Jakhar *et al.*, 2016) [19]; 0.17±0.04 (Jamuna *et al.*, 2015a) [21] in Murrah buffalo to 0.34 (Parmar *et al.*, 2019) [31] in Mehsana buffalo; 0.20 (Kumar *et al.*, 2000) [26] to 0.30 (Patil *et al.*, 2018) [33] and 0.27 (Chakraborty *et al.*, 2010b) [8] to 0.28 (Patil *et al.*, 2018) [33], respectively.

The content of table 1 reveals the heritability estimates of different fertility traits as age at first calving, service period, conception rate, calving interval, number of services per conception and pregnancy rate ranges from 0.07 (Seno *et al.*, 2010) [38] to 0.37 (Wakchaure *et al.*, 2008) [49]; 0.07 (Kumar, 2000) [26] to 0.32 (Dev *et al.*, 2015) [15]; 0.08 (Dash *et al.*, 2015); 0.02 (Patil *et al.*, 2018) to 0.38 (Dev *et al.*, 2015) [15]; 0.18 (Patil *et al.*, 2018) and 0.06 (Dash *et al.*, 2015) [12] to 0.09 (Jamuna *et al.*, 2015b) [22], respectively.

Conclusion

The basic objective of animal breeders is to maximize the production in the farm and carry the production along with its enhancement to next generation. Selection of elite animals keeping in the mind the health status and production efficiency of the animals as to accurately identifying the parents for next generation. Judicious use and meticulous mating of the superior germplasm owning animals gives the tremendous results. Basically, the selection of animals is done on their past records and performances of their parents, siblings and relatives. The variation in the production performance might come from the environmental factors, selection process or combination of both factors. As the literature, non-genetic factors like period of calving, season of calving and parity of animals significantly influenced the production performance traits in Murrah buffaloes. Therefore, adjustment for non-genetic effect is crucial for the accuracy of estimation of genetic parameters.

References

1. Aziz MA, Schoeman SJ, Jordaan GF, El-Chafie OM, Mahdy AT. Genetic and phenotypic variation of some reproductive traits in Egyptian buffalo. South African Journal of Animal Science. 2001, 31(3). http://www.sasas.co.za/Sajas.html
2. BAHS. Basic animal husbandry statistics, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture. Government of India. Krishi Bhawan, New Delhi; c2022.
3. Barman RSD. Studies on non-genetic factors affecting first lactation and life time performance traits in Murrah buffaloes. M.V.Sc. thesis submitted to H.A.U. India; c2009.
4. Barman RSD, Grewal SS, Dalal DS, Ahmad M, Mahto D. Non-genetic factors affecting first lactation production traits in Murrah buffaloes. Ind. Vet. J. 2012;89(8):53-55.
5. Bharat NK, Thapan PC, Gahlot GC. Production and reproduction performance of light breed of buffaloes. Indian Journal of Animal Science. 2004;74(5):527-529.
6. Catillo G, Moii B, Nap Itan F. Estimation of Genetic Parameters of Some Productive and Reproductive Traits in Italian Buffalo. Genetic Evaluation with BLUP-Animal Model. Asian-Aust. J of Animal Sciences; c2001. p. 747-753.
7. Chakraborty D, Dhaka SS, Pander BL, Yadav AS, Danpat A. Genetic studies on 305 day and test day records in Murrah buffaloes. Indian Journal of Animal Sciences. 2010a;80:729-732.
8. Chakraborty D, Dhaka SS, Pander BL, Yadav AS. Genetic studies on production efficiency traits in Murrah buffaloes, Ind. J of Animal Sciences. 2010b;80(9):898-901.
9. Chander R. Prediction of the breeding value of sires for life time performance traits in Murrah buffaloes. Ph.D. Thesis, Haryana Agricultural University. Hisar; c2002.
10. Chaudhari M. Genetic studies on production, fertility and longevity traits in Murrah and Nili-Ravi buffaloes M.V.Sc. thesis submitted to LLR Univ. of Veterinary and Anim. Sci. Hisar; c2015.
11. Chowdhary MS, Chowdhary AL. Studies on peak yield and days to attain peak yield in Mehsana and Surti buffaloes. Ind. Vet. J. 1981;58:203-207.
12. Dash SK, Gupta AK, Singh A, Shivahre PR, Panmei A, Singh M. Comparative assessment of sire evaluation by univariate and bivariate animal model for estimation of breeding values of first lactation traits in HF cross cattle. Ind. J. of Ani. Sci. 2016;86(2):177-179.
13. Dass G, Sadana DK. Factors affecting some economical traits in Murrah buffaloes. Indian J Anim. Res. 2000;34:43-45.
14. Deshpande KS, Deshpande AD, Deshpande KS. Genetic studies in production efficiency traits in Jersey cows. Indian J Anim. Sci. 1992;62:169-170.
15. Dev K, Dhaka SS, Yadav AS, Sangwan SK. Genetic parameters of early performance traits in Murrah Buffaloes. Haryana Vet. 2015;54(2):144-146.
16. Godara A. Genetic studies on performance traits in different lactation of Murrah buffaloes. M.Sc. Thesis submitted to CCS Haryana Agricultural University, Hisar, India; c2003.
17. Gupta JP, Sachdeva GK, Gandhi RS, Chakaravarty AK. Non-genetic factors influencing growth and production performance in Murrah buffaloes. Indian J Dairy Sci. 2012;65(3):239-241.
18. Hussain Z, Javed K, Hussain SMI, Kiyani GS. Some environmental effects on productive performance of Nili-Ravi buffaloes in Azad Kashmir. J Anim. Pl. Sci. 2006;16(34):66-69.
19. Jakhar V, Vinayak AK, Singh KP. Genetic Evaluation of Performance Attributes in Murrah Buffaloes, Haryana Vet. 2016;55(1):66-69.
20. Jamal I, Mehla RK, Yousuf S, Naik MA, Japeth KP. Effect of non-genetic factors on various reproduction traits in Murrah buffaloes. Indian J Dairy Sci. 2018;71(2):193-197.
21. Jamuna V, Chakravarty AK, Singh A, Patil CS. Genetic parameters of production and fertility traits in Murrah Buffaloes. Indian J. Anim. Res. 2015a;49(3):288-291.
22. Jamuna V, Patil CS, Chakravarty AK. Influence of non-genetic factors on performance traits in Murrah buffaloes. Indian J Anim. Res. 2015b;49(3):279-283. Print ISSN:0367-6722 / Online ISSN:0976-0555
23. Katneni VK. Studies on genetic persistency of milk production in Murrah buffaloes. Ph.D. Thesis submitted

to Karnal, Haryana, India: NDRfI (Deemed University); c2007.
24. Kaur R, Malhotra P, Kashyap N, Dash SK, Kaur S. Analysis of different non-genetic factors affecting production performance of Murrah buffaloes. Ind. J of Ani. Res. 2020 Apr;54(4):517-519, 3.
25. Kumar M, Ratwan P, Patil CS, Vohra V. Influence of Environmental Factors on Performance Traits in Murrah Buffaloes: A Review. Research & Reviews: Journal of Veterinary Science and Technology. ISSN: 2319-3441 (Online), ISSN: 2349-3690 (Print). 2017;6(1) www.stmjournals.com
26. Kumar A. Genetic studies on first lactation traits in Murrah buffaloes. M.V.Sc. thesis, Haryana Agricultural University, Hisar, India; c2000.
27. Kumar D, Singh H, Singh CV. Genetic studies of different components of milk production efficiency in Murrah buffaloes. Ind. J Anim. Sci. 2000;70:82-83.
28. Kumar V, Chakravarty AK, Patil CS, Valsalan J, Sharma RK, Mahajan A. Genetic studies of first lactation production traits of Murrah buffaloes under network project of buffalo improvement. Ind. Vet. J. 2014;91(07):26-28.
29. Lathwal SSz Optimum levels of economic traits for maximizing the profit function in Murrah buffaloes. Ph.D. Thesis, NDRI (Deemed University), Karnal, Haryana, India; c2000.
30. Pareek NK, Narang R. Genetic analysis of first lactation persistency and milk production traits in graded Murrah buffaloes. Buffalo Bulletin. 2014;33(4):432-436.
31. Parmar GA, Gupta JP, Chaudhari JD, Pandey DP, Prajapati BM, Sathwara RN, *et al*. Study of genetic and non-genetic factors affecting age at first calving and wet average in Mehsana buffaloes. Buff. Bulletin. 2019;38(1):11-17.
32. Pathodiya OP, Jain LS. Studies on first lactation ratio traits in Surti buffaloes. Indian J Dairy Sci. 2004;57:429-431.
33. Patil HR, Dhaka SS, Yadav AS, Patil CS. Comparison of genetic parameters of production efficiency and fertility traits in Murrah buffaloes. Int. J Adv. Biolog. Res. 2018;8(1):82-85.
34. Pawar HN, Kumar GVPPSR, Narang R. Effect of Year, Season and Parity on Milk production traits in Murrah buffaloes. J Buff. Sci. 2012;1:122-125.
35. Prakash A, Tripathi VN. Factors affecting production characters of Murrah buffaloes. Ind. J Dairy Sci. 1987;43:178-180.
36. Sachan CB, Kushwaha BP, Kundu SS. ‘Production performance of Bhadawari buffaloes at organized herd.’ National Symposium on Conservation and Improvement of Animal Genetic Resources under Low Input System; c2006 Feb 9–10. p. 138.
37. Sarkar U, Gupta AK, Mohanty TK, Raina VS, Parsad S. Estimates of genetic parameters for lactation milk constituents and yield traits in Murrah buffaloes. J Dairying Foods and Home Sci. 2006;25:149-151.
38. Seno LO, Cardoso VL, Faro LEl, Sesana RC, Aspilureta-Borquis RR, Camago de GMF, *et al*. Genetic parameters of milk yield, age at first calving and interval between First and second calving in milk Murrah buffaloes, Livestock Research for Rural Development. 2010, 21(2).
39. Sidgel A, Kolachhapati ML, Bhattarai N. Effect of non-genetic factors on productive traits of murrah buffaloes. Nepalese J Agri Sci. 2014;12:148-152.
40. Singh CV, Barwal RS. Use of different animal models in prediction of genetic parameters of first lactation and herd life traits of Murrah buffaloes. Indian J Dairy Sci. 2012;65(5):399-404.
41. Singh TP, Singh R, Singh G, Das KS, Deb SM. Performance of production traits in Nilli-Ravi buffaloes. Indian J Anim. Sci. 2011;81(12):1231-1238.
42. Suresh R, Bidarkar DK, Gupta BR, Sudharkarrao B, Sudhakar K. Production and reproduction performance of Murrah buffaloes. Ind. J Anim. Sci. 2004;748:854-857.
43. Tanpure Mahesh U, Suryawanshi, Vaibhav R, Jadhav Sahadeo S. Study of productive and reproductive traits of Murrah buffaloes.Golden Research Thought. 2013;3(3):1.
44. Tekerli M, Gundogan M. Effect of certain factors on productive and reproductive efficiency traits and phenotypic relationships among these traits and repeatability in West Anatolian Holsteins. Turk. J Vet. Anim. Sci. 2005;29:17-22.
45. Thiruvenkadan AK. Performance of Murrah buffaloes at coastal region of Tamil Nadu, India. Indian J Anim. Sci. 2011;81(10):1080-1083.
46. Thiruvenkadan AK, Panneerselvam S, Murali N, Selvam S, Sarvanakumar VR. Milk production and reproduction performance of Murrah buffaloes of Tamil Nadu, India. Buffalo Bulletin. 2014;33(3):291-300.
47. Thiruvenkadan AK, Panneerselvam S, Rajendrean R, Murali N. Analysis on the productive and reproductive traits of Murrah buffalo cows maintained in the coastal region of India. Appl. Anim. Husb. Rural Develop. 2010;3:1-5.
48. Verma MK, Sachdeva GK, Yadav AK, Gautam S, Ali MM, Santosh Kumar. Effect of genetic and non-genetic factors on milk yield and milk constituents in Murrah buffalo. Ind. J of Anim. Res. 2017;51(2):387-90.
49. Wakchaure RS, Amit K, Sachdeva GK, Gandhi RS. Time Series analysis of first lactation traits in Murrah Buffalo. Indian J Dairy Sci. 2008;61:374-376
50. Yadav BS, Yadav MC, Khan FH. Murrah buffaloes- II. First lactation yield and first lactation period. Buffalo Bulletin. 2002;21(3):51-54.
51. Singh B, Singh JP, Kaur A, Singh N. Bioactive compounds in banana and their associated health benefits–A review. Food chemistry. 2016 Sep 1;206:1-1.
52. Gupta HV, Kling H, Yilmaz KK, Martinez GF. Decomposition of the mean squared error and NSE performance criteria: Implications for improving hydrological modelling. Journal of hydrology. 2009 Oct 20;377(1-2):80-91.
53. Pandey P, Ramegowda V, Senthil-Kumar M. Shared and unique responses of plants to multiple individual stresses and stress combinations: physiological and molecular mechanisms. Frontiers in Plant Science. 2015 Sep 16;6:723.