

Relationship of linear type traits with production and reproduction performance in Murrah buffaloes

S P DAHIYA, MANOJ KUMAR* and SANDEEP DHILLOD

Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana 125 004 India

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ABSTRACT

Murrah is the world famous milch breed of buffaloes. The aim of present study was to study the variability in body conformation traits as well as to assess the relationship of body conformation traits with production and reproduction performance of Murrah buffaloes. The measurements on 81 lactating Murrah buffaloes maintained at Buffalo Farm, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar were recorded for 11 morphometric traits, viz. top wedge angle, rump slope, rump width, hip bone distance, navel flap length, brisket distance, height at wither, body length, skin thickness at neck region, skin thickness at chest region and skin thickness at flank region and their means along with standard errors were 46.9 ± 0.5 degree, 13.0 ± 0.6 degree, 17.7 ± 0.3 cm, 47.0 ± 0.4 cm, 1.8 ± 0.1 cm, 24.3 ± 0.5 cm, 138.5 ± 0.4 cm, 148.9 ± 0.8 cm, 6.7 ± 0.1 cm, 9.0 ± 0.2 cm and 11.3 ± 0.2 cm, respectively. Additionally, four performance traits namely first lactation milk yield, age at first calving, service period and calving interval were also recorded and their means were found to be 2934.4 ± 95.9 kg, 42.8 ± 0.6 months, 141.7 ± 9.9 days and 446.6 ± 12 days, respectively. The top wedge angularity and hip bone distance had significant positive correlations with first lactation milk yield (0.42 and 0.52 respectively). Highest (0.86) and significant correlation was observed between service period and calving interval. The results suggest that Murrah buffaloes with higher top wedge angularity and wider hip bone distance are better in milk production and these traits can be used for selection of high producing buffaloes in the absence of milk records under field conditions.

Keywords: Linear type traits, Murrah, Phenotypic correlation, Production, Reproduction

Buffaloes, with a population of 109.85 million contribute around 20.45% to the total livestock population in India (20th Livestock Censuses) and account for about 49.2% of total milk production in the country (DAHD 2017–18). The population of Murrah buffalo in India is 48.25 million (pure and graded). In addition to India several countries including China, Brazil, Bulgaria, Bangladesh, Egypt, etc. have used Murrah breed (Fig. 1.) as an improver breed for upgrading their native buffaloes due to its higher milk production and good reproduction potential coupled with adaptation to wide environmental conditions and good feed conversion efficiency.

Linear type traits are the external body parts of buffalo, which make her capable of producing milk and are directly or indirectly associated with each other (Dubey 2010). Murrah, Surti, Nili-Ravi buffaloes and their crosses showed great variation in external conformation and economic traits under field conditions of Sri Lanka (Charlini and Sinniah 2015). Scheinder *et al.* (2003) reported that linear type traits play significant role during selection as well as reproduction decisions in Holstein dairy cattle. Zavadilova and Stipkova (2012) found that linear type traits affect selection and culling decisions directly or indirectly in Czech Holstein

cattle. Linear type traits also affect the longevity as well as milk production in dairy cattle (Atkins and Shannon 2002; Renno *et al.* 2003) and may be used as indirect predictors of milk production and longevity (Esteves *et al.* 2004).

Information on relationship of linear type traits with production and reproduction performance in Murrah buffaloes is scanty and very little work has been done so far. Ugar *et al.* (2005) reported significant correlations between some linear type traits and milk production in dairy animals. The study of external body structure of dairy



Fig. 1. Murrah buffalo

*Corresponding author e-mail: drmanojneemwal@gmail.com

buffaloes is not only essential to demonstrate the breed standards of buffaloes but also for their high milk productivity as well as good reproduction status. The present study was undertaken to make a descriptive analysis of body morphometric measurements in Murrah buffaloes and to estimate their phenotypic correlations with production and reproduction performance.

MATERIALS AND METHODS

A total of 81 lactating Murrah buffaloes of Buffalo Farm, LUVAS, Hisar were recorded for 11 body morphometric traits. Top wedge angle was measured as the angle between the hip bones from the point at wither. Rump slope was taken as the angle of the rump structure from hips to pins. Rump width included the distance between the most posterior point of pin bones. The hip bone distance was taken as distance between two hip bones measured with the help of measuring tape. Navel flap length was measured with the help of scale. Brisket distance was measured as the distance between forelegs with help of measuring tape. The wither height was measured when the animal was in standing position evenly on the ground with normal posture. Body length was taken as the distance from the point of shoulder to the point of pin bone. Skin thickness was recorded at three sites with the help of Vernier calliper over the side skin of the buffalo's neck region, chest and flank region. The reading of Vernier calliper for skin fold thickness at each site was divided by two to know the exact skin thickness value. In addition to traits type, the data of these animals were also recorded for first lactation milk yield, age at first calving, calving interval, service period and calving pattern. The data were analysed using standard statistical procedure (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

Morphometric traits: In the study, a total of 11 morphometric traits, viz. top wedge angle (TWA), rump slope (RS), rump width (RW), hip bone distance (HBD), navel flap length (NFL), brisket distance (BD), height at wither (HW), body length (BL), skin thickness at neck region (NST), skin thickness at chest region (CST), skin thickness at flank region (FST) were measured and results are presented in Table 1. The average value for top wedge angle was found to be 46.9 ± 0.5 degree and range was 35–56 degree with variability of 10.5%. Mean rump slope was observed as 13.0 ± 0.6 degree varying from 10–23 degree with 40.1% variability. In present study, the average value for rump width was found to be 17.7 ± 0.3 cm and varied from 13 to 27.5 cm with 13.6% variability. Bedoya and Hernandez (2013) and Kocaman *et al.* (2017) observed comparatively higher values for rump width in buffaloes. Kocaman *et al.* (2017) reported 20 cm rump width in riverine buffaloes maintained at Istanbul. Campanile *et al.* (2003) had observed the ischium width of 24.8 cm in Mediterranean buffalo. However, much higher average rump width was reported by Andrea *et al.* 2010 (49 cm) and Rezende *et al.* 2017 (32 cm) in Murrah buffaloes in

Table 1. Descriptive analysis of the body morphometric measurements as well as production and reproduction traits of Murrah female buffaloes

Variable	N	Mean \pm S.E.	Range	C.V. (%)
Top wedge angle (TWA)	81	46.9 \pm 0.5 degree	35–56	10.5
Rump slope (RS)	81	13.0 \pm 0.6 degree	0–23	40.1
Rump width (RW)	81	17.7 \pm 0.3 cm	13–27.5	13.6
Hip bone distance (HBD)	81	47.0 \pm 0.4 cm	36–55	7.9
Navel flap length (NFL)	81	1.8 \pm 0.1 cm	0.2–5.5	69.7
Brisket distance (BD)	81	24.3 \pm 0.5 cm	15–34	16.8
Height at wither (HW)	81	138.5 \pm 0.4 cm	129–149	2.9
Body length (BL)	81	148.9 \pm 0.8 cm	127–161	4.6
Skin thickness (Neck region) (NST)	81	6.7 \pm 0.1 cm	4.7–1	17.2
Skin thickness (Chest region) (CST)	81	9.0 \pm 0.2 cm	5.6–12	15.9
Skin thickness (Flank region) (FST)	81	11.3 \pm 0.2 cm	7.8–16	16.5
Average skin thickness (ST)	81	9.0 \pm 0.14 cm	6.4 – 11.9	14.4
First lactation milk yield (FLMY)	54	2934.4 \pm 95.9 kg	969–4285	24
Age at first Calving (AFC)	62	42.8 \pm 0.6 months	33.6–54	11.3
Service period (SP)	46	141.7 \pm 9.9 days	51–307	47.6
Calving pnterval (CI)	46	446.6 \pm 12 days	301–660	18.2
Calving pattern (CP)	62	Normal (61)	Abnormal (1) – Normal (61)	–

Brazil. The vast variability in average rump width in different studies might be due to variation in genetic makeup of buffaloes and also due to method of measurement in different studies. Rump width is an important parameter which indicates the good fertility in female dairy animals (Buranakarl *et al.* 2013). Ramos (2008) reported that wider rump width will help in proper uterine development and favours normal calving. The average value for hip bone distance was observed as 47.0 ± 0.4 cm in present study. The minimum value for hip bone distance was found to be 36 cm whereas maximum was 55 cm and variability was found to be 7.9%. Average hip bone distance (44 cm) reported by Bedoya and Hernandez (2013) in Murrah buffaloes at Colombia was in correspondence with the present findings. Melo *et al.* (2018) reported comparatively less hip bone distance as 39.9 cm. On the contrary, Dhillod *et al.* (2017) observed higher (62.24 ± 0.48 cm) hip bone distance in Murrah buffaloes. More hip bone distance reflects better

Table 2. Phenotypic correlation of body measurements as well as production and reproduction traits of Murrah buffaloes

	TWA	RS	RW	HPD	NFL	BD	HW	BL	NST	CST	FST	FLMY	AFC	SP	CI
TWA	1.00														
RS	0.12	1.00													
RW	0.23	0.26*	1.00												
HPD	0.57**	-0.05	0.40**	1.00											
NFL	0.14	-0.14	0.08	0.28*	1.00										
BD	0.00	-0.06	0.30*	0.38**	0.19	1.00									
HW	0.50**	0.17	0.41**	0.52**	0.24	0.24	1.00								
BL	0.50**	-0.08	0.45**	0.44**	0.17	0.23	0.48**	1.00							
NST	0.09	-0.09	0.00	0.12	0.31*	0.05	0.00	0.10	1.00						
CST	0.23	-0.20	0.04	0.28*	0.35**	0.14	0.12	0.20	0.54**	1.00					
FST	0.21	-0.08	-0.02	0.28*	0.28*	0.23	0.21	0.23	0.64**	0.67**	1.00				
FLMY	0.42**	-0.05	0.05	0.52**	0.23	0.06	0.10	0.06	0.11	0.22	-0.08	1.00			
AFC	0.14	-0.14	0.00	0.28*	0.09	0.08	0.21	0.04	-0.07	0.12	0.17	0.07	1.00		
SP	-0.05	-0.02	-0.09	-0.02	0.12	-0.01	0.04	-0.31*	-0.02	-0.02	-0.12	0.35*	0.01	1.00	
CI	-0.13	-0.11	-0.11	-0.17	0.01	-0.13	-0.04	-0.31*	0.08	0.05	-0.11	0.33*	-0.14	0.86**	1.00

*, **Significant at 0.05 level and 0.01 level respectively. TWA, Top wedge angle; RS, Rump slop; RW, Rump width; HPD, Hip bone distance; NFL, Navel flap length; BD, Brisket distance; HW, Height at wither; BL, Body length; NST, Skin thickness at neck region; CST, Skin thickness at chest region; FST, Skin thickness at flank region; FLMY, First lactation milk yield; AFC, Age at first calving; SP, Service period.

reproductive ability in females in relation to development of foetus and nature of calving.

Navel flap length varied from 0.2 to 5.5 cm and had average value of 1.8 ± 0.1 cm. High variability (69.7%) was observed for the navel flap length in Murrah buffaloes. The mean value for brisket distance (BD) was found to be 24.3 ± 0.5 cm. Brisket distance varied from 15–34 cm and had 16.8% variability. Literature was scanned for these two traits (navel flap length and brisket distance) in Murrah buffaloes but no reference was available till date. Average height at wither (HW) in Murrah buffaloes was found to be 138.5 ± 0.4 cm in this study. The individual measurements varied from 129–149 cm with variability of 2.9% for height at wither. The average value for body length was 148.9 ± 0.8 cm with range and variability as 127–161 cm and 4.6%, respectively. Average height at wither and body length in Murrah buffaloes as observed in the present study were comparable to the findings of Dhillod *et al.* (2017). They observed 135.78 ± 0.46 cm as height at wither and 152.23 ± 0.83 cm as average body length in Murrah buffaloes. Andrea *et al.* (2010) and Melo *et al.* (2018) observed comparatively lower body length in Murrah buffaloes. Ahmad *et al.* (2013) and Kocaman *et al.* (2017) reported 140 cm and 146 cm body length, respectively in Nilli-Ravi buffaloes. In Azikheli buffaloes, Khan *et al.* (2013) observed body length as 140 cm. On the contrary, longer average body length was reported by Mirza *et al.* 2015 (156 cm) in the Nili Ravi buffaloes of Pakistan.

Skin thickness was observed at three different regions, i.e. neck, rib and rump in this study. Average skin thickness was found to be 9.0 ± 0.14 cm. Individual measurements ranged from 6.4–11.9 cm and variability was 14.4%. Mean values of skin thickness for neck, rib and rump region were observed as 6.7 ± 0.1 , 9.0 ± 0.2 and 11.3 ± 0.2 cm, respectively. Range and variability of these traits is presented in the

Table 1. Among the three regions, neck region skin thickness had maximum variability followed by rump and rib region skin thickness.

Production and reproduction traits: First lactation milk yield varied from 969–4285 kg with an average of 2934.4 ± 95.9 kg (Table 1). Average age at first calving was found to be 42.8 ± 0.6 months in this study with variability of 11.3%. The average service period was observed as 141.7 ± 9.9 days and it varied from 51–307 days. Calving interval ranged from 301–660 days with average calving interval as 446.6 ± 12 days. All the buffaloes except one had normal calvings. First lactation milk yield observed in the present studies was comparatively higher than the average first lactation milk yield as reported by other workers in Murrah buffaloes. Dhillod *et al.* (2017), Kumar *et al.* (2017) and Chitra *et al.* (2018) reported first lactation milk yield as 2604.77 ± 39.47 kg, 2045.30 ± 52.15 kg and 1977.9 ± 36.2 in Murrah buffaloes. Age at first calving reported by Jamal *et al.* (2018) and Kumar (2015) were 46.62 months and 47.57 months, respectively which is higher as compared to our findings in Murrah buffaloes. In this study, average service period and calving interval were observed as 141.7 ± 9.9 days and 446.6 ± 12 days, although Jamal *et al.* (2018) reported comparatively higher service period (147.85 ± 2.12 days) and calving interval (455.041 ± 3.14 days) in Murrah buffaloes. Dahiya *et al.* (1994) also reported genetic variability in some performance traits of Murrah buffaloes.

Phenotypic correlations: Phenotypic correlations were studied among morphometric and performance traits (Table 2). On perusal of results, it is evident that maximum correlation (0.67) was observed between skin thickness at rib and rump region among the morphometric traits. Hip bone distance was positively and significantly correlated with almost all traits except rump slop, service period and

calving interval. Among performance traits service period and calving interval had highly significant positive correlation (0.86) indicating that prolonged service period leads to increase in the calving interval. First lactation milk yield had highest correlation with hip bone distance (0.52) followed by top wedge angle (0.42) depicting that these two morphometric measurements can be used for prediction of first lactation milk yield in Murrah buffaloes at an early age. In the present study, first lactation milk yield was positively correlated with naval flap length, neck and chest skin thickness but negatively correlated with flank region skin thickness. Service period and calving interval were negatively correlated with body length in Murrah buffaloes indicating that the Murrah buffaloes with higher body length are more efficient in reproductive performance. Manik *et al.* (1981) observed no correlation between skin thickness and milk production in Murrah buffaloes. Barati *et al.* (2017) reported that negative correlation was found between daily milk yield and skin thicknesses at different region and significant correlations were also seen with skin thickness of flank and udder regions. Bhatnagar and Kumar (1980) also found negative and significant correlation between average milk yield and skin thickness measured at different region in cows. They reported that skin thickness of abdomen region in Sahiwal cattle revealed maximum correlation but in case of crossbred cattle, skin thickness of dewlap region revealed maximum correlation. Kshatriya *et al.* (2009) also found significant negative correlations between skin thickness at neck, chest and flank region with milk yield in indigenous as well as crossbred cattle.

In conclusion, an important finding of the present study is that top wedge angularity and hip bone distance had significant positive correlations with first lactation milk yield (0.42 and 0.52, respectively). These results suggest that Murrah buffaloes with higher top wedge angularity and wider hip bone distance are better in milk production besides having optimum reproductive performance. Hence these two traits can be used as selection indicators for selecting high producing Murrah buffaloes under field conditions in the absence of milk production records. The results also point towards the need of more detailed studies to establish genetic relationship between linear type traits and production performance of buffaloes.

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