EFFECT OF NONGENETIC FACTORS ON SEMEN PRODUCTION CHARECTERISTICS OF MURRAH BUFFALO BULLS AT ORGANIZED SEMEN STATION

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ABSTRACT

A study was conducted on Murrah buffalo male calves born during 1997 to 2012, reserved for breeding at Indian Council of Agricultural Research, National Dairy Research Institute, Karnal, Haryana, India to assess the influence of season and period of birth on semen production characteristics of buffalo bulls. Chi-square analysis revealed that neither season nor period had significant effect on these parameters. The result depicted that 36.47% males donated semen and 28.68% males produced freezable quality semen out of reserved males. Overall least squares means of age at first successful semen collection (AFSC), age at first successful freezing (AFSF), age at last successful freezing (ALSF), age at last successful semen collection (ALSC), semen production period (SPP), frozen semen production period (FSPP) and age at disposal (AD) were 1073.5±28.41, 1196.05±28.18, 1600.26±143.18, 1570.33±101.55, 644.28±112.05, 712.33±159.08 and 1668.25±128.53 days, respectively. Effect of season and period of birth was not found significant for all the traits except for ALSC which showed declining trend over the periods. Significant effect ($P<0.05$) of age group showed that the bulls donating semen for the first time at younger age also produced semen of freezable quality at a younger age and remained in the herd producing semen for a longer duration. The age at first semen donation in Murrah males can be reduced by introducing the young male calves to training at an early age, which could increase the doses of semen obtained from each male.

Keywords: semen, AFSC, AFSF, ALSF, ALSC, Murrah

INTRODUCTION

Murrah buffalo is the most efficient producer of milk and known for its better adaptability throughout India. The breeding tract of Murrah breed lies in Rohtak, Hisar and Jind district of Haryana and Nabha and Patiala districts of Punjab in India. The germplasm and bulls of this breed are used extensively for upgrading native buffalo stock of many countries including Thailand, Malaysia, Indonesia, Philippines, Madagaskar and Brazil. It has been anticipated

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that buffalo is the future hope to meet the milk and meat demond in the densely populated countries like India and China (Ranjhan and Qureshi, 2006). The buffaloes are kept under peri-urban and rural farming systems with the primary aim to produce milk for urban and rural populations. Since artificial insemination (AI) was introduced to the dairy industry in the 1950s, it has become the preferred method of breeding in most developing countries of the world. The optimum serving capacity and seminal profile are the crucial parameters to assess the breeding soundness of bovine bulls. Age of the bull affects semen volume and sperm concentration (Amann and Almquist, 1976; Rustenev, 1989 and Siratskii, 1990). Through seasonal variation in semen production has been reported (Graffer *et al*., 1988), but specific causes are not understood. A better knowledge of the influence of age of the bull at collection, season of collection, and frequency of collection on semen production will help the AI industry to adapt management of bulls to improve semen output. Differences in age at puberty may be attributed to breed composition, management, and environment in which bulls were being reared (Brito *et al*., 2004). To gain a better understanding of semen production of Murrah bulls, 16 years of data from Artificial Breeding Research Centre, National Dairy Research Institute, Karnal were analyzed.

MATERIALS AND METHODS

Data on Murrah buffalo males born during the period from 1997 to 2012 were collected from Artificial Breeding Research Center, Indian Council of Agricultural Research-National Dairy Research Institute, Karnal to study the effect of season of birth, period of birth and age group on semen production traits of Murrah males. The following traits were generated i.e. Age at disposal (AD), Age at first successful semen collection (AFSC), Age at first successful freezing (AFSF), Age at last successful freezing (ALSF), Age at last successful semen collection (ALSC), Frozen semen production period (FSPP) and Semen production period (SPP). Data were classified into four periods viz., P-1 (1997 to 2000), P-2 (2001 to 2004), P-3 (2005 to 2008), P-4 (2009-2012); four seasons viz., winter, summer, rainy and autumn i.e. S-1 (December to March), S-2 (April to June), S-3 (July to September), S-4 (October to November), respectively; and age groups D1 (<2.5 years), D2 (2.5 to 3 years), D3 (3 to 3.5 years) and D4 (>3.5 years); to study semen production characteristics of Murrah males calves reserved for breeding. The semen production traits of breeding bulls in different seasons and periods of birth were calculated by proportion using descriptive statistics. To study the differences in number of males reaching semen production stage, Chi-square value was calculated (Snedecor and Cochran, 1968).

The statistical model used for least square analysis to study effect of season of birth and period of birth on age at first semen collection (AFSC) was as under:

$$Y_{ijk} = \mu + SB_i + P_j + e_{ijk}$$

Where

Y_{ijk} = k^{th} observation of a bull born in i^{th} season and jth period

μ = overall mean

SB_i = Effect of i^{th} season of birth (i=1to 4)

P_j = Effect of j^{th} period of birth (j=1to 4)

Eijk = Random error NID (0, σ_e^2)

The model used to study the effect of age,

season and period on AFSF, ALSF, ALSC and AD was:

$$Y_{ijkl} = \mu + SB_i + P_j + D_k + e_{ijkl}$$

Where

Y_{ijkl} = l^{th} observation in in i^{th} season and j^{th} period and belonging to k^{th} age group

μ = overall mean

SB_i = Effect of I^{th} season of birth (i=1to 4)

P_j = Effect of j^{th} period of birth (j=1to 4)

D_k = Effect of k^{th} age group of the bull donating semen for the first time (k=1 to 4)

e_{ijkl} = Random error NID (0, σ_e^2)

RESULTS AND DISCUSSION

During study period 1029 male animals were born out of which 244 (23.71%) males were reserved for breeding purpose on the basis of dam's best 305 day lactation yield. Average dam's best 305 days lactation yield was 2879.93 kg for selected vs 2311.45 kg for all the males born. Out of total reserved males 28.68% bulls produced semen and out of which 78.57% bulls were able to produce freezable quality semen. Period-4 was excluded from the data set as a number of bulls from this period could not reach the semen donation stage. Analysis of production of breeding bulls from males reserved for breeding purpose revealed that percent bulls reached upto semen donating stage and successful freezing out of total males reserved for breeding was 31.55 and 25.40% respectively whereas only 80.51% bulls gives freezable quality semen out of total bulls reaching the semen donation stage. Chi-square analysis revealed that season and period of birth had no significant effect on AFSC and AFSF. In Period-2, 46.55% males reached the semen donation followed by Period-1 (42.11%) and Period-3 (31.70%), this may be due to managemental difference in the farm during the periods. Whereas male born in rainy season, 40.20% reached into AFSC i.e. maximum compared to other seasons. If we compare the males reaching AFSF stage out of males reaching the semen donation stage, it was seen that maximum 85.71% males reached to AFSF, born in winter season and minimum (62.50%) in summer season. The results showed that the males born during summer months, very few of them reached successful freezing stage prior to being considered for inclusion in progeny testing programme. It may be due to winter born males got quality feed and fodder during their growth period than summer born males.

Overall least squares means for age at first semen collection (AFSC), age at first successful freezing (AFSF), age at last successful freezing (ALSF), age at last semen collection (ALSC), semen production period (SPP), freezable semen production period (FSPP) and age at disposal (AD), were 1073.5±28.41, 1196.05±28.18, 1600.26±143.18, 1570.33±101.55, 644.28±112.05, 712.33±159.08 and 1668.25±128.53 days respectively (Table 3). Higher values of AFSC were reported by Suryaprakasam and Rao (1993) (1326±1.2) and Khate (2005) (1179.02±27.25) in Murrah. Kodagali *et al.* (1980), while studying the culling percentage of Surti buffalo bulls, reported the mean age at disposal (AD) and breeding tenure as 2,330 and 480 days, respectively. Mukhopadhyay *et al.* (2010) had reported higher values of AFSC, AFSF, SPP and AD but lower value of FSPP. Similarly Khatun *et al.* (2013) had reported higher values of all these traits. This may be due to variation in managemental conditions or geographical locations of farm differences. The results indicated that average age at first semen collection was on higher side, therefore management of males from

Table 1. Number of Murrah buffalo males reserved, donated semen and produced freezable quality semen.

Breed	No. born	Reserved	Produced semen	Produced freezable quality semen
Murrah	1029	244 (23.71)	70 (28.68)	55 (78.57)

Figure in parentheses indicate percentage.

Table 2. Effect of season and period of birth on AFSC (Bulls donating semen) and AFSF (Bulls producing freezable quality semen) of Murrah buffalo bulls.

Period	No. born	No. reserved	% AFSC out of reserved	% AFSF out of AFSC	Overall % AFSF out of reserved
P-1 (1997-2000)	275	57	42.10 (24)	95.83 (23)	40.35
P-2 (2001-2004)	256	58	46.55 (27)	70.37 (19)	32.75
P-3 (2005-2008)	252	82	31.70 (26)	76.92 (20)	24.39
P-4 (2009-2012)	246	47	-	-	
Overall	1029	244	31.55 (77)	80.51 (62)	25.40
Chi-square value			1.50	0.60	2.10
Season					
S-1 (Dec-Mar)	311	59	35.59 (21)	85.71 (18)	30.50
S-2 (Apr-Jun)	135	33	24.24 (8)	62.50 (5)	15.15
S-3 (Jul-Sep)	389	97	40.20 (39)	84.61 (33)	34.02
S-4 (Oct-Nov)	194	55	38.18 (21)	71.42 (15)	27.27
Overall	1029	244	36.47 (89)	78.65 (70)	28.68
Chi-square value			1.4	0.40	2.60

Figure in parentheses indicate number of bulls.

Table 3. Effect of season, period and age group on Least squares means of semen production characteristics of Murrah buffalo bulls.

Effects	AFSC (days)	AFSF (days)	ALSF (days)	ALSC (days)	SPP (days)	FSPP (days)	AD (days)
No. of bulls	89	71	53	69	54	38	72
Overall	1073.5± 28.41	1196.05± 28.18	1600.26± 143.18	1570.33± 101.55	644.28± 112.05	712.33± 159.08	1668.25± 128.53
Period of birth							
P-1 (1997-00)	1090.88± 48.77	1203.98± 41.38	1806.35± 152.53	1871.18± 134.21^{a}	726.7±146.88	732.56± 198.92	1951.97± 138.69
P-2 (2001-04)	1016.16± 44.59	1186.87± 45.69	1742.08±166.56	1648.19± 124.10^{ab}	651.06± 148.48	788.53± 210.44	1794.07± 127.77
P-3 (2005-08)	1171.81± 44.12	1278.80± 36.16	1648.58± 153.26	1629.79± 123.01^{ab}	555.09± 156.26	615.9± 184.88	1773.01± 133.36
P-4 (2009-12)	1015.17± 65.05	1114.55± 57.91	1204.02± 379.98	1132.17± 269.68^{b}	-	-	1153.93± 399.67
Season of birth							
Winter season	1096.18± 49.11	1204± 46.37	1629.41± 189.06	1666.41± 155.97	680.03± 151.30	695.02± 174.75	1670.97± 172.77
Summer season	1066.55± 78.77	1226.27± 76.12	1420.28± 373.82	1399.69± 236.09	502.18± 290.41	568.71± 512.94	1695.81± 265.34
Rainy season	1101.90± 36.12	1196.38± 29.18	1735.80± 130.45	1685.08± 106.30	859.26± 110.68	801.42± 117.50	1673.35± 131.56
Autumn season	1029.40± 48.06	1157.25± 42.26	1615.53± 194.76	1530.14± 153.25	535.67± 188.69	784.18± 228.56	1632.84± 179.87
Age Group							
D1 (<2.5 yrs)	-	1088.52± 47.33^{ac}	1749.36±209.65	1711.97± 180.94	1211.7± 175.11^{a}	1014.05± 186.21	1793.38± 205.13
D2 (2.5-3 yrs)	-	1093.71± 35.28^{a}	1737.46± 159.75	1610.41± 118.23	808.8± 120.62^{a}	891.42± 166.61	1832.26± 141.42
D3 (3-3.5 yrs)	-	1200.07± 37.28^{c}	1482.18± 159.90	1488.71± 133.22	475.81± 143.40^{b}	674.35± 209.69	1642.53± 166.14
D4 (>3.5 yrs)	-	1401.91± 68.59^{b}	1432.02± 281.80	1470.23± 213.54	80.81± 305.56^{ab}	269.51± 368.72	1404.80± 229.27

Mean with similar superscript do not differ significantly (*P<0.05).

AFSC = Age at first semen collection; AFSF = Age at first semen freezing; ALSF = Age at last semen freezing; ALSC = Age at last semen collection; SPP = Semen production period; FSPP = Frozen semen production period; AD = Age at disposal

young age in scientific line as well as introducing them at appropriate age for semen donation. Lower age at disposal and frozen semen production period could be due to early fulfillment of desired number of frozen semen doses from the breeding bulls.

The results showed that AFSC, AFSF, ALSF and ALSC were the lowest in bulls born in Period-4 (1015.17±65.05, 1114.55±57.91, 1204.02±379.98 and 1132.17±269.68 days) whereas, AFSC and AFSF was highest in Period-3 (1171.81±44.12 and 1278.80±36.16 days) while ALSF, ALSC, SPP and AD was highest in Period-1 (1806.35±152.53, 1871.18±134.21, 726.7±146.88 and 1951.97±138.69). FSPP was found to be the highest in Period-2 i.e. 788.53±210.44 days, reflecting the changes in management from time to time at Artificial Breeding Research Centre. The effect of period of birth on ALSC was found significant ($P<0.05$). Chauhan *et al.* (2010) conducted a study on Karan Fries and found effect of period of birth to be significant for AFSC, AFSF, ALSC, and AD. Similarly Mukhopadhyay *et al.* (2010) found effect of period of birth to be significant for AFSC, AFSF, SPP, FSPP and AD in Karan Fries, Sahiwal cattle and Murrah bulls.

Effect of season of birth on AFSC and AFSF showed that in autumn it was the lowest i.e. 1029.40±48.06 and 1157.25±42.26 days it may be due to feed and fodder availability resulted in better nutrient availability to male born in autumn season. Whereas male born in summer showed lowest ALSF, ALSC, SPP and FSPP values i.e. 1420.28±373.82, 1399.69±236.09, 502.18±290.41 and 568.71±512.94, respectively. The bulls born in autumn season reached AFSC and AFSF earlier than those born in other seasons. The bulls born during rainy season were the last to donate their first semen whereas males born in summer season stopped donating semen earlier than the bulls born in other seasons. Males born in autumn season performed better in term of semen donation as well as semen freezing while males born on other seasons are not performing upto mark. Therefore management decision can take care of this to manipulate the breeding condition of the female herd to optimize maximum number of birth of males offspring in favorable season. The season of birth had no significant effect on AFSC, AFSF, ALSF, ALSC SPP, FSPP and AD. Season of birth has its effect up to a first few months of age of the animal and gradually diminishes. In similar line Chauhan *et al.* (2010) and Mukhopadhyay *et al.* (2010) also found no significant effect of season on any of these traits.

The effect of age at sexual maturity was significant ($P<0.05$) on AFSF and SPP. The males donating semen at an early age reached in freezable quality semen production stage i.e. 1088.52±47.33 and it increased in case of males donating semen at later ages. ALSF, ALSC, SPP and FSPP was found maximum in males donating semen at earlier age i.e. 1749.36±209.65, 1711.97±180.94, 1211.7±175.11 and 1014.05±186.21 days, respectively and the estimates revealed decreasing trend with the bulls donating semen at higher age. Age of disposal (AD) was found maximum in D-2 (2.5 to 3 years) age group and minimum in D-4 (>3.5 years) age group which may be due to poor semen quality donation. The effect of age of the bull at first collection was important for young bulls, likely because of physiological changes that occur during their growth to the stage of sexual maturity (Mathevon *et al*., 1998). Chauhan *et al*. (2010) reported that age group had significant effect on AFSF.

CONCLUSION

Semen donation parameters, like age at first semen collection, age at first semen freezing, semen production period and freezen semen production period were not significantly affected by period and season of birth in Murrah buffalo bulls. The age at first semen donation in Murrah males can be reduced by introducing the young male calves to training at an early age, which could increase the doses of semen obtained from each male. Better managemental practices and regular monitoring of breeding soundness may improve the reproductive performance of Murrah buffalo breeding bulls.

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