EFFECT OF SEASON ON SEMEN QUALITY PARAMETERS IN MURRAH BUFFALO BULLS


1 Artificial Breeding Research Centre, National Dairy Research Institute, Karnal, Haryana, India
2 Livestock Research Centre, National Dairy Research Institute, Karnal, Haryana, India
3 Sheep Research Station, Faculty of Veterinary Science and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Shuhama, Alusteng, Srinagar, Kashmir (J&K), India

ABSTRACT

The present study was undertaken to know the seasonal influence on various seminal attributes in Murrah buffalo bulls. Data on 156 ejaculates of eight Murrah buffalo bulls (nearly 30 to 58 months) maintained under identical nutrition and management conditions were selected randomly from Artificial Breeding Complex, NDRI, Karnal, India, from May 2006 to April 2007. The information on 156 ejaculates was subjected to least square analysis to quantify the effect of non genetic factor (summer, rainy and winter) on various semen quality parameters. The overall least square mean values of the 8 Murrah buffalo bulls for ejaculate volume (ml), mass activity, Initial motility (%), Sperm concentration (10⁶/ml), Total sperm output (10⁶), Non-eosinophilic count (%), HOST (%), Acrosome integrity (%), Head abnormality (%), Mid-piece abnormality (%), Tail abnormality (%), Total abnormality (%), pH and Osmolality (mOsmol/Kg) were 2.66±0.10; 2.54±0.70; 60.64±0.02; 1016.68±21.25; 2748.67±122.86; 67.20±0.03; 40.88±0.03; 52.72±0.01; 70.10±0.02; 2.30±0.001; 1.62±0.01; 5.50±0.002; 9.47±0.002; 6.78±0.20 and 277.78±2.40, respectively. Seasonal variations had no significant effect on ejaculate volume (2.69, 2.71 and 2.56), mass activity (2.56, 2.40 and 2.67) and total sperm output (2510.08, 2812.44 and 2923.49) in Murrah buffalo bulls, but it had a significant (P<0.05) effect on pH (6.85, 6.77 and 6.71) of semen. The present data clearly indicated that there was highly significant (P<0.01) effect of season on seminal attributes such as initial motility (56.18, 59.64 and 65.74), sperm concentration (870.62, 1028.20 and 1151.20), non-eosinophilic count (61.91, 65.65 and 73.74), HOST reacted sperm percent (47.05, 48.32 and 62.67), acrosome integrity (65.04, 68.64 and 76.28), sperm abnormalities (HEAD: 2.79, 2.68 and 1.53; MP: 2.15, 1.58 and 1.19; TAIL: 7.11, 5.61 and 4.01 and TOTAL: 12.11, 9.90 and 6.76) and osmolality (288.05, 279.81 and 265.48) of semen. During hot dry (summer) season, the highest values of VOL, sperm abnormalities, pH and OSMOL and lowest MA, IM, SPC, SPCE, LIVE, HOST and AI were observed. During hot-humid (rainy) season, intermediate values of all the seminal attributes were observed. During cold (winter) season highest magnitude of MA, IM, SPC, SPCE, LIVE, HOST and AI were observed. During hot-dry season adversely affect the various bio-
physical characteristics of semen in Murrah buffalo bulls. Winter was the most favourable season for good quality semen production and the rainy season might be considered as the intermediate between the two extremes.

**Keywords:** season, semen quality parameters, Murrah buffalo bull

**INTRODUCTION**

In recent years animal climatology as a subject of systemic study has gained recognition and the results achieved so far emphasize the importance of further concerned and intensive study of the subject in relation to animal productivity. In addition to the fundamental aspect of temperature adaptation by farm animals the subject has been approached from its applied aspect as well namely the economy of production, e.g., milk production, rate of survival, growth and fertility. As an offshoot of these studies has grown newer concepts of management- feeding and handling of animals and designs for housing or shelter for the livestock as well as the lay-out of the immediate surrounding to the animal houses. In the tropical climate heat-stress is largely responsible for the low animal productivity. Tropical countries like India where ambient temperature remains above the thermo-neutral zone of the farm animals for a large part of the year. Nearly 90% of the rainfall takes place in northern regions during three successive months of the year. Since productivity is primarily determined by the extent of the utilization of the available natural resources as well as the direct effects of climatic components on the physiology of the animals, it is necessary to ascertain the detrimental influences of climatic condition on animal productivity. Investigations carried out under carefully controlled conditions have shown that both the magnitude and duration of stress induced by the adverse environmental condition influences the animal’s physiological reactions and production, in the experimental location. The maximum and minimum temperature during the summer months varies from 30 to 46°C and the annual rainfall is about 760 to 960 mm which is mostly received during the month of July and August and the relative humidity ranges from 45 to 99 percent. The stressful effect of such a severity of weather condition was further aggravated by the stress imposed by direct and reflected solar radiations. Many places in northern India such an environment characteristics of the summer is encountered for a period of 50 to 100 days and animal in the field, during summer, is not only burdened with the above heat load but also the stress is further aggravated by exposure to the sun for over 12 h a day foraging in terrains which are sandy and devoid of sufficient vegetation cover. It is under such environment that the farm animal exists in the semi-arid zones of northern India (Sengupta et al., 1963).

An extraordinary long calving interval in buffalo is a result of many factors of which the seasonality in the breeding of females and its effect on the libido and semen production of the bulls is the most distinct one (Zafar et al., 1988). In farm animals though the spermatogenesis activity is a continuous process with the attainment of puberty, many investigation have shown that the quality and quantity of semen may vary during different season of the year. In buffalo bulls it is not conclusive due to the lack of sufficient reports and the variable results may be particularly due to different agro climatic conditions under which the experiments were carried out (Gupta et al., 1978; Zafar et al.,
1988; Bhosrekar et al., 1992b; Prajapati, 1995; Bhat et al., 2004; Koonjaenak et al., 2007). Among different seasons hot-dry and hot-humid season reported to be unfavourable for production as well as reproduction. The effect of season is both direct and indirect. It affects the animal directly through macro and micro climatic factors, like temperature, humidity, rainfall and photoperiod. Indirectly it acts by affecting the vegetation, forage quality and soil-plant-animal interaction. The magnitude of variations differs from breeds, location, prevailing climatic conditions, feeding and general management (Mandal et al., 2000).

Information regarding the effect of seasons on semen characteristics in Murrah buffalo bulls had been of conflicting nature. Some research workers had reported ill effects of heatstress (Gupta et al., 1978; Bhosrekar et al., 1992b; Prajapati, 1995), while others observed (Bhat et al., 2004) similar findings during the winter season; whereas such effects had been reported in the spring season by Sengupta et al. (1963). Ravimurugan et al. (2003) and Bhat et al. (2004) reported monsoon proved to be best season for production of quality semen in Murrah buffalo bulls. The knowledge of trend of seasonal influence on semen characteristics would help to know the requirement of bulls to meet the demand of frozen semen and to provide any suitable additional managerial requirements time to time. Hence, the present study was undertaken to investigate the effect of seasons on various characteristics of semen production in Murrah buffalo bulls keeping in view the specific consideration of climatic components.

**MATERIALS AND METHODS**

The present experiment was conducted on 8 Murrah bulls (30 to 58 months of age and 518.58 to 782.50 kg body weight) maintained at Artificial Breeding Complex, NDRI, Karnal, India. Data were collected from 156 ejaculates over a period of one year (May, 2006 to April, 2007). The farm is situated at an altitude of 250 meters above the mean sea level on 29.43°N latitude and 72.2°E longitude. The bulls were maintained identical and optimal conditions of feeding and management during the entire course of the experiment. The bulls were healthy, free from diseases, sexually mature, good libido and clinically normal, randomly selected from the herd. The year was subdivided into three seasons: Hot Dry or summer (April to June); Hot Humid or Rainy (July to October) and Cold or winter (November to March). Semen was collected in the morning once a week from the bulls using sterilized bovine artificial vagina (IMV model-005417) (temp 42-45°C), using dummy bull. Soon after collection volume was measured and each ejaculate was placed in a water bath at 30°C and various standard laboratory tests for semen were recorded. Semen was assessed for mass activity and individual motility using DIC phase contrast microscope (Nikon Eclipse E600, Tokyo, Japan) with Tokoiheat thermal stage as per standard method. Mass motility was expressed qualitatively in (0-5) scale as per the description given by Tomar et al. (1966). Sperm concentration was estimated by Haemocytometer (Improved Neubauer’s chamber) method. pH of the fresh semen was determined within 15 minutes of collection with Cyberscan 510 pH meter (Eutech Instrument, Singapore) and osmolality by WESCOR vapour pressure Osmometer (WESCOR model 5500, INC, USA). The live and dead spermatozoa count was determined as per the method of Bloom (1950) and Hancock (1951) and the same slide was used to determine the sperm abnormalities. The hypo-
osmotic swelling test was performed according to the methods described by Correa and Zavos (1994). Staining was carried out as described by Hancock (1952) for acrosome integrity.

To study the effect of season on the semen quality parameters (volume, mass activity, sperm concentration, total sperm production, motility, non-eosinophilic count, HOST reacted sperm count, intact acrosome, sperm abnormality studies) the following least square model has been used. Prior to the analysis proportionality data (motility, percent non-eosinophilic count, HOST, acrosome integrity and abnormality data) were transformed using the arcsine transformation [asin (sqrt (percent/100))] (Snedecor and Cochran, 1994) with adjustment to allow for zero values.

\[
Y_{ik} = \mu + S_i + e_{ik}
\]

Where,

- \(Y_{ik}\) = \(k^{th}\) record of seminal parameter collected on a bull in \(i^{th}\) season
- \(S_i\) = Effect of \(i^{th}\) season of collection \([i=1\ (Hot\ Dry\ (Summer):\ April\ to\ June), 2\ (Hot\ Humid\ (Rainy):\ July\ to\ October) \& 3\ (Cold\ (Winter):\ November\ to\ March)]\]
- \(e_{ik}\) = Random error associated with \(Y_{ik}\) which is assumed to be normally and independently distributed with mean zero and constant variance.

The recorded data were subjected to statistical analysis using LSML-91 software package, Walter Harvey.

RESULTS AND DISCUSSIONS

Although spermatogenesis is a continuous process in male once it has reached reproductive maturity, the semen of farm animals exhibits a distinct climatic pattern with respect to its quality and fertilizing efficiency. Least squares means of various seminal attributes of Murrah buffalo bulls during different season are presented in Table 1.

Seminal attributes

Seasonal variations had no significant effect on ejaculate volume (VOL), mass activity (MA) and total sperm output (SPCE) in Murrah buffalo bulls, but it had a significant (\(P<0.05\)) effect on pH of semen. The present data clearly indicated that there was highly significant (\(P<0.01\)) effect of season on seminal attributes such as initial motility (IM), sperm concentration (SPC), non-eosinophilic count (LIVE), HOST reacted sperm percent (HOST), acrosome integrity (AI), sperm abnormalities (head, mid-piece, tail and total) and osmolality (OSMOL) of semen.

In the present study the overall least squares mean of ejaculate volume of Murrah buffalo bulls was found to be 2.66 ± 0.10. The ejaculate volume was highest during rainy and lowest during winter season (2.71 vs. 2.56). Bhattacharya et al. (1978) and Mandal et al. (2000) reported highest semen volume in Murrah bulls during summer season and lowest during winter season. However, Rao et al. (1991) and Ravimurugan et al. (2003) obtained highest ejaculate volume during rainy season; Sengupta et al. (1963) and Singh and Singh (1993) reported highest semen volume during spring season. No significant seasonal difference was observed in ejaculate volume which is in agreement with the findings of Oloufa et al. (1959) in Egyptian buffalo bulls; Tomar et al. (1966) in Murrah bulls; Manik and Mudgal (1984) in Murrah buffalo bulls and Koonjaenak et al. (2007) in Swamp buffalo. Several factors such as, age of the animal, differences between species, number of specimens, level of nutrition, management practice and environment conditions etc. may be responsible for the differences in results.
Table 1. Least squares means ± S.E. for effect of season on semen quality parameters of Murrah buffalo bulls.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Hot Dry (Summer) (N=34)</th>
<th>Hot Humid (Rainy) (N=53)</th>
<th>Cold Humid (Winter) (N=69)</th>
<th>Overall (N=156)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.E.</td>
<td>Mean</td>
<td>S.E.</td>
</tr>
<tr>
<td>Ejaculate volume (ml)</td>
<td>2.69</td>
<td>0.21</td>
<td>2.71</td>
<td>0.17</td>
</tr>
<tr>
<td>Mass activity (0-5 Scale)</td>
<td>2.56</td>
<td>0.14</td>
<td>2.40</td>
<td>0.11</td>
</tr>
<tr>
<td>Initial motility (%)</td>
<td>56.18</td>
<td>a 0.08</td>
<td>59.64</td>
<td>a 0.05</td>
</tr>
<tr>
<td>Sperm concentration (10^6/ml)</td>
<td>870.62</td>
<td>A 42.23</td>
<td>1028.20</td>
<td>B 34.08</td>
</tr>
<tr>
<td>Total sperm output (10^9)</td>
<td>2510.08</td>
<td>244.19</td>
<td>2812.44</td>
<td>197.03</td>
</tr>
<tr>
<td>Non-eosinophilic count (%)</td>
<td>61.91</td>
<td>a 0.11</td>
<td>65.65</td>
<td>a 0.07</td>
</tr>
<tr>
<td>HOST (%)</td>
<td>47.05</td>
<td>A 0.06</td>
<td>48.32</td>
<td>A 0.04</td>
</tr>
<tr>
<td>Acrosome integrity (%)</td>
<td>65.04</td>
<td>a 0.10</td>
<td>68.64</td>
<td>a 0.06</td>
</tr>
<tr>
<td>Head abnormality (%)</td>
<td>2.79</td>
<td>A 0.001</td>
<td>2.68</td>
<td>B 0.001</td>
</tr>
<tr>
<td>Mid-piece abnormality (%)</td>
<td>2.15</td>
<td>A 0.001</td>
<td>1.58</td>
<td>B 0.001</td>
</tr>
<tr>
<td>Tail abnormality (%)</td>
<td>7.11</td>
<td>A 0.006</td>
<td>5.61</td>
<td>B 0.004</td>
</tr>
<tr>
<td>Total abnormality (%)</td>
<td>12.11</td>
<td>A 0.008</td>
<td>9.90</td>
<td>B 0.005</td>
</tr>
<tr>
<td>pH</td>
<td>6.85</td>
<td>A 0.41</td>
<td>6.77</td>
<td>AC 0.03</td>
</tr>
<tr>
<td>Osmolality (mOsmol/Kg)</td>
<td>288.05</td>
<td>A 4.76</td>
<td>279.81</td>
<td>A 3.84</td>
</tr>
</tbody>
</table>

Least squares means bearing different alphabets as superscripts differ significantly row-wise (aP<0.05, bP<0.01).
The overall least squares mean of mass activity (MA) was found to be 2.54 ± 0.70. Mass activity was the maximum during winter, followed by summer and rainy season (2.67, 2.56 and 2.40). The highest mass activity during winter season had been reported in Murrah buffalo bulls (Manik and Mudgal, 1984; Mandal et al., 2000); Mehsana (Prajapati, 1995) and Surti buffalo bulls (Bhosrekar et al., 1992b), however, in Murrah bulls Bhosrekar (1980) and Dhami et al. (1998) observed its highest value during rainy season, whereas Zafar et al. (1988) obtained no significant seasonal variation in mass activity in Nili-ravi bulls as it was found in the present study. Results are conflicting because mass motility was subjectively determined by microscopic examination of a drop of fresh semen; these data should be considered with caution.

Significant (P<0.01) seasonal difference was observed in percent initial motility (IM) which is in agreement with the findings of Tuli and Singh (1983) in Murrah buffalo bulls and Bhosrekar et al. (1992b) in Surti buffalo bulls and Ravimurugan et al. (2003) in Murrah buffalo bulls. On the contrary, Oloufa et al. (1959) in Egyptian buffalo bulls; Gupta et al. (1978) in Surti buffalo; Zafar et al. (1988) in Nili-ravi buffalo bulls; Bhosrekar et al. (1991) in Murrah buffalo bulls; Prajapati (1995) in Mehsana; Mandal et al. (2000) in Murrah buffalo bulls and Koonjaenak et al. (2007) in Swamp buffalo did not obtain any significant seasonal variation in IM. The initial motility was found to be maximum during winter (65.95 vs. 56.18 and 59.64 %) which varied significantly (P<0.05) in summer and rainy season.

Sperm concentration per unit volume of the semen is perhaps one of the most studied seminal attributes in relation to seasonal variation of semen quality. The results revealed that the sperm concentration per ml (SPC) varied significantly (P<0.01) among seasons being maximum during winter followed by rainy and summer season (1151.20, 1028.20 and 870.62 × 10⁶/ml) which is corroborate with the report of Mandal et al. (2000) and Ravimurugan et al. (2003) in Murrah bulls. The difference in SPC between seasons was significant (P<0.01). Bhosrekar (1980) and Manik & Mudgal (1984) reported highest SPC during summer season in Murrah, where as Prajapati (1995) and Dhami et al. (1998) obtained highest value during rainy season; however, in Egyptian buffalo bulls Oloufa et al. (1959) observed its highest value during spring. On the contrary, Zafar et al. (1988) in Nili-Ravi buffalo bulls; Bhosrekar et al. (1992a) in Murrah; Bhosrekar et al. (1992b) in Surti and Koonjaenak et al. (2007) in Swamp buffalo obtained no significant seasonal variation in sperm concentration. The differences between this and other studies might be the result of length of the study period, as well as differences in the age and breed of the bulls. In the present finding lower concentration of spermatozoa during the summer may be due to significant reduction in the feed intake and increase in dead and abnormal spermatozoa. Dead and abnormal spermatozoa, which are absorbed by leucocytes through phagocytosis (Mann and Mann, 1981). The increased resorption of abnormal spermatozoa leads to reduction in epididymal sperm reserves (Rao et al., 1980), thus decreasing concentration. This finding support to the conclusion that the spermatozoa produced during summer were either intrinsically less active and vigorous at the time of production or that they, though normal at the time of genesis, suffered deterioration at some stage of their passage down the male reproductive tract prior to their release in the ejaculate under sustained impact of a climatically stressful summer environment.

Total sperm output (SPCE) was maximum
during winter followed by rainy and summer season (2923.49, 2812.44 and 2510.08×10^6). As the sperm concentration per ml was highest during winter season resulted in maximum sperm output per ejaculate. However, Prajapati (1995) in Mehsana; Singh et al. (1992) in Mehsana; Gupta et al. (1978) in Surti; Rao et al. (1991) in Murrah and Mandal et al. (2000) in Murrah buffalo bulls obtained maximum output during rainy season, whereas Bhavsar et al. (1986) obtained highest sperm per ejaculate in autumn season in Mehsana bulls. However, Koonjaenak et al. (2007) in Swamp buffalo observed no significant seasonal variation in total sperm output. These variations may be due to managemental conditions, laboratory method of estimating sperm concentration.

Significant (P<0.01) seasonal variation in non-eosinophilic sperm percent was observed. Highest live sperm percent was observed during winter, followed by rainy and summer season (73.74, 65.65 and 61.91%). The live sperm percent was found to be maximum during winter which varied significantly (P<0.05) with summer and rainy season. Our results are in agreement with the findings of Gupta et al. (1978) in Surti and Mandal et al. (2000) in Murrah buffalo bulls. Sengupta et al. (1963); Manik and Mudgal (1984) and Dixit et al. (1984) also reported lowest live sperm count during summer season. However Bhosrekar (1981) and Singh and Singh (1993) observed lowest value of live sperm percent in Murrah bulls during winter season and Prajapati (1995) reported lowest value during rainy season in Mehsana bulls. The occurrence of lowest percentage of live spermatozoa synchronizing with the part of year characterized by the highest mean ambient temperature suggests that the summer environment becomes instrumental in causing death and abnormality to have an opportunity to come out in the ejaculate.

Significant (P<0.01) seasonal variation in hypo-osmotic swelling test (HOST) reacted spermatozoa was observed in the present investigation being maximum during winter season followed by rainy and summer season (62.67, 48.32 and 47.05%). However the variation between summer and rainy season was non-significant. The results obtained here are quite similar to those reported by Mandal et al. (2000) in Murrah buffalo bulls. Whereas, Koonjaenak et al. (2007) reported PMI was highest in summer and lowest in winter (P<0.05).

Percentage of spermatozoa with intact acrosome were found to be significantly (P<0.01) affected by seasons. The lowest acrosome integrity percent was observed during summer and highest during winter season (65.04 vs. 76.28%). However the variation between summer and rainy season was non-significant (65.04 and 68.64 %). However, Manik and Mudgal (1984) and Mandal et al. (2000) reported lowest value during summer, whereas, Singh and Singh (1993) reported lowest value during winter season.

The variation in head, mid-piece, tail and total abnormality percent were highly significant (P<0.01) among the seasons. All the abnormalities were found to be higher during summer followed by rainy and winter seasons (HEAD- 2.79, 2.68 and 1.53; Mid-piece- 2.15, 1.58 and 1.19; TAIL-7.11, 5.61 and 4.01; TOTAL- 12.11, 9.90 and 6.76 %). Significant (P<0.01) variation between season were also observed in case of all the abnormalities. Bhavsar et al. (1990) in Mehsana buffalo bulls and Mandal et al. (2000) in Murrah buffalo obtained almost similar types of results, but Manik and Mudgal (1984) and Bhosrekar et al. (1991) reported higher abnormality during winter season. Whereas, Koonjaenak et al. (2007) reported significant
seasonal influence on sperm morphology. He also found that among morphological abnormalities, only proportions of tail defects were affected by season, being highest in the rainy season and lowest in summer \( (P < 0.001) \).

Significant \( (P<0.05) \) seasonal difference in pH was observed in the present study. This may be due to seasonal fodder changes. During summer pH was high may be due to silage feeding. On the contrary, Koonjaenak et al. (2007) in swamp buffalo reported no significant seasonal variation in pH. Mandal et al. (2000) also observed similar results in Murrah buffalo bulls. Highly significant \( (P<0.01) \) variations due to season were observed in case of osmolality, being maximum during summer, followed by rainy and winter seasons \( (288.05, 279.81 \) and \( 265.48 \% ) \). Heat stress increases loss of body fluid due to sweating and panting, if the stress continues for a longer period the fluid loss can reach critical level (Kadzere et al., 2002) and may be reflected in the seminal plasma which is evident from the above finding that osmolality was highest during the hot dry season. The reason for variation in osmolality of seminal plasma is not clearly known, however, it may be due to fluctuation in core body temperature, seasonal fodder changes and changes in thermodynamics of body. On the other side may be variation of environmental temperature has effect on the osmolality reading by the vapor pressure machine to the extent of 5 to 7\%. Individual variation might be attributed to the genetic makeup, age, nutrition and the influence of the climatic components, which might have transduced variably into endocrine messages controlling hypophyseal-hypothalamo-gonadal axis.

Haryana is the home track of the Murrah buffalo and they are very much adaptable to the environment. Normal management practices in the field condition to ameliorate heat stress is by wallowing in the village pond or in irrigation canal for longer part of the day, when the solar radiation and heat is maximum, but in case of our farm condition we are not able to provide such type of facilities for breeding bulls. Sprinkling facility is available during this period. In case of female buffaloes, providing mist, forced cooling and wallowing improves productivity. In general summer may be regarded as the season exerting relatively more adverse effect on the overall semen quality than the other seasons. This appears quite likely in view of the high ambient temperature, a relatively long spell of that high temperature, hot blast of wind (Loo) and a continuous stream of radiation impinging directly and indirectly through reflection from terrains or shed on the animal’s body and thereby precipitating a really distressing challenge to the animal’s thermo-regulatory mechanism. The buffalo bulls seem to be susceptible to either extremes of heat and cold. But under the experimental conditions it appeared that they were more tolerant towards the colder months as compared to the hotter months. It will be apparent from the climatic table that winter in this part can be considered neither extreme nor severe to the extent to being definitely detrimental. The semen picture during winter was better to that of rainy and summer season.

Semen quality in bull reflects the degree of normality of the function of their testes, ducti epididymides and genital tract (including the accessory sex glands). The normality of the genital system also depends on the hormonal balance of the bull, which is sensitive to changes in health status, nutrition and management. Changes in these conditions influence sperm output, accessory sex gland secretion and epididymal function, all of which are reflected in the in the semen quantitative
(ejaculate volume, sperm concentration and total sperm output per ejaculate) and qualitative characteristics (mass motility, individual motility, non-eosinophilic, abnormal sperm percent, intact acrosome and spermatozoa with intact plasma membrane percent). The sperm quality in the ejaculate, regarded as the sum of these variables. Furthermore, external cues such as seasonality also appear to influence sexual function, either through photoperiod (Barth and Waldner, 2002) or through changes in ambient temperature (Fayemi and Adegbite, 1982; Sekoni and Gustafsson, 1987).

The time course of spermatogenesis in the bull is as follows: the transformation of committed A spermatogonia to B2 spermatogonia takes 20 days, of B2 spermatogonia to pachytene spermatocyte takes 10 days, of pachytene spermatocyte to early round spermatid takes 13.5 days, of early round spermatid until release into the lumen takes 17.5 days, epididymal transit time is six to eight days (Amann and Schanbacher, 1983). The numbers of sperm and morphology of the semen finally ejaculated are determined by the numbers of stem cells recruited to undergo spermatogenesis and by the mortality throughout spermatogenesis, particularly at the pachytene spermatocyte and early round spermatid stage. Hence semen quality at any time is likely to reflect the environmental influences upon the sensitive stages of spermatogenesis, which is highly sensitive to even short increases in scrotal temperature, as has been recorded in Bos taurus AI sires kept in temperate regions (Januskauskas et al., 1995). From the findings of the present investigation, it could be inferred that the hot seasons was the worst for semen production in Murrah buffalo bulls. It might be attributed to the fact that heat stress reduces the release of GnRH, which in turn affected the release of hormones responsible for spermatogenesis. Heat stress might have also increased the release of ACTH, which inhibits the effect of LH, an important hormone responsible for spermatogenesis. Clarke and Tilbrooke (1992) reviewed the effects of heat and various other environmental stresses in different species of livestock. It indicated that the stressors in general affect the normal process of reproduction in a multi-dimensional way by reducing feed intake, impairing either the release or response to the important hormones of reproduction, like GnRH, LH and increased levels of plasma corticosteroids, have inhibitory effect on LH. However, the exact effects on gonadal functions on dairy bulls need to be investigated. Besides, decline in thyroxin level during hot-dry and hot-humid seasons as compared to winter (Madan, 1985) impaired the general metabolism and feed intake and could be instrumental in causing reproductive dysfunctions (Zafar et al., 1988). The temperature sensitive muscles of the testis- tunica dartos and external cremaster muscles get relaxed to its maximum limit to keep testicles cool, after that core temperature goes on increasing. Nonetheless, increased core temperature of testes might have reduced the activity of enzymes responsible for spermatogenesis and impaired the normal process of reproduction. A few investigators (Kushwaha et al., 1955; Gopalakrishna and Rao, 1978) have attributed the low breeding efficiency of buffaloes during summer due to deterioration of semen quality, but this has been disputed by others (Tomar et al., 1964; Chaudhary and Gangwar, 1977).

As the sexual activity of each species including human beings, is highly influenced by the environment of the surroundings, the variation in these parameters are quite obvious with reference to time, place and subject concerned. In summer, extreme heat stress causes physical exhaustion, which might reduce the eagerness of the bulls and
thus, result in higher reaction time and total time for successful ejaculation, thus having an ultimate effect on production of sperms Mandal et al. (2000). Reasons for good quality seminal ejaculates during winter might be attributed to the congenial weather condition which affects the activity and secretions of accessory reproductive glands, since the secretions are dependent on testosterone liberated by interstitial cells during this season which might have favoured the process of spermatogenesis Mandal et al. (2005). Madan (1985) found that thyroxin was higher during cold as compared to hot-dry and hot-humid seasons. Thyroxin is one of the primary metabolic hormones which bear the significance in this regard. Application of Vaseline during winter season prevented the cracking of the skin as result damage to testicular tissue may be very minute.

CONCLUSION

Thus, it may be concluded that the hot-dry or summer season adversely affect the various biophysical characteristics of semen in Murrah buffalo bulls. Winter was the most favourable season for good quality semen production and the rainy season might be considered as the intermediate between the two extremes. The procedure of semen quality assessment, instruments used, expertise of different evaluator, replications of the experiment and seasonal classification might have resulted in little consistency in results. Most of the workers while describing the seasons attributed the given months to constitute them in quarters without giving specific consideration to the duration of prevalence of dry heat, moist heat, cold conditions, etc., which exert their influence directly or indirectly on semen production and other related physiological functions of the breeding bulls. In general it is suggested that during summer, breeding bulls should be kept cool and comfortable by splashing water at least 3-4 times a day, protected from direct wind blasts, housed in a place with comfortable micro-environment with least humidity, fed during cool hours and have a free access to cool drinking water.

ACKNOWLEDGEMENT

We are thankful to Director, NDRI for providing the necessary funding to carry out the research work.

REFERENCES


