http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 7 (12): 2177-2181, 2004
ISSN 1028-8880

Evaluation of Bulls Based on Semen Quality and Herd Fertility

M.P. Mostari, M.G.M. Rahman, M.A.M.Y. Khandoker and S.S. Husain
Department of Animal Breeding and Genetics, Bangladesh Agricultural University,
Mymensingh-2202, Bangladesh

Abstract: The data of the present study were collected from Bangladesh Milk Producers' Co-operative Union Limited (BMPCUL) at Baghabarighat, Sirajgong, Bangladesh to evaluate the bull performance through semen quality and 30-day Non Return Rate (NRR). Data on 245 ejaculates and 12,750 services of almost same aged of 5 Sahiwal bulls (B_1, B_2, B_3, B_4 and B_5) over a period of 5 years were collected from Animal Breeding Section and Cattle Feed Unit of BMPCUL. The significant ($p<0.01$) individual sire effect was found on semen volume, three stages of sperm motility (initial, on dilution and post-thawing) and fertility. Significant ($p>0.05$) variation was not found for pH. The highest volume of semen per ejaculate, the initial, on dilution and post-thawing sperm motility were found in bull B_4 and representing 5.60±0.19 mL, 73.56±0.61, 69.27±0.33 and 63.90±0.48%, respectively. The highest sperm motility was found in initial stage and then declined steadily up to post-thawing stage. Significant ($p<0.01$) positive correlations were observed between the three stages of sperm motility and fertility. The results of the present study revealed that evaluation of breeding bulls on the basis of semen quality and herd fertility is important and provides the guideline of the way to sire selection for reproductive performance.

Key words: Breeding bull, semen, evaluation, herd fertility

INTRODUCTION

The main avenue of livestock development through selective breeding is the selection of breeding male[1]. It has to be ensured that regular supplies of genetically superior males to the cows to which they are mated are available at breeding station. Evaluation of female is also important but is limited by the fact that each cow normally has only one calf each year and a high proportion of female is required for herd replacement. Selection of males on the other hand, is much more efficient because a bull can produce thousands of calves a year through Artificial Insemination (AI). The economic states of bull are associated with their reproductive efficiency and the reproductive indices are considered as the major criteria of culling. The reproductive parameters are therefore, required to be known for the bull to estimate their performance. Evaluation of the semen characteristics is the most effective parameters for selecting breeding bulls. The quality of semen in relation to fertility is determined largely by the motility of sperm. The quality of semen again depends on concentration of spermatozoa, proportion of live and morphologically normal spermatozoa, seminal pH and optimum metabolic features of individual sperm[2]. Since fertility is obtained from the results of conception and it is obvious that fertility of bull is a matter of great importance[3]. So particular attention should be paid in this parameter of bulls all the year round during the tenure of their life at any breeding station. Artificial Insemination (AI) is one of the potent tools for rapid genetic improvement on the basis of physiology of reproduction and sire evaluation. This is possible because a few highly selected males produce enough spermatozoa to inseminate thousands of females per year. So to bring any AI program into success, the poor quality semen or bull must be avoided from insemination. To evaluate the fertilizing capacity of the semen sample a reasonable number, at least 800 of cows need to be inseminated and after 30 to 60 days non-return rate of the cows can be estimated[4]. Such method is reliable and also gives economic incentive in an AI program.

Bangladesh Milk Producers' Co-operative Union Ltd. (BMPCUL), Baghabarighat, Sirajgong is one of the self sufficient and profitable milk producing enterprises and the reliable breeding and reproductive record keeper organization in Bangladesh. The average milk production per day at Baghabari milk shed area is 1,11,500 L. It is believed that the exploitation of suitable genetic resource available at the location could be the most important elements of the story behind the success of BMPCUL.

Corresponding Author: Dr. M.A.M. Yahia Khandoker, Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
Tel: +880 91 55695/2270 Fax: +880 91 55810 E-mail: yahiakh@royalten.net

Crossing of local cows with Sahiwal bulls by generations has enabled the farmers of Baghabarighat milk pocket area to develop a type of cattle[5]. As far as we know the reproductive performance of these bulls has not performed yet. Therefore, the aim of the present study was to evaluate the Sahiwal bulls used for breeding purpose at BMPCUL based on semen quality and herd fertility.

MATERIALS AND METHODS

Time and place of the study: The present study was undertaken at Baghabarighat milk shed area under BMPCUL, a large dairy pocket of Bangladesh, popularly known by the brand name "Milk Vita", located at Sirajgong district, Bangladesh. The whole activities considered in this study covers the period from 1996 to 2000.

Animals and data used: In 1994, five Sahiwal bulls were imported at BMPCUL from Pakistan. These bulls were numbered as B_1, B_2, B_3, B_4 and B_5. Collected semen was evaluated and processed for freezing and these bulls provided a total of 12,750 services. The deep frozen semen is used at BMPCUL. Cows under the study area have developed through crossing of the local cows with Sahiwal bulls by generations and develop a type of cattle provisionally called "Pabna Type"[5]. They were free from reproductive diseases and were identified in heat and inseminated using the semen thus introduced. The information regarding semen quality of these bulls were collected from the records kept in Animal Breeding Section and Cattle Feed Unit while the data of fertility based on 30-day NRR of each bull were accumulated from the record sheets maintained by relevant Livestock Field Assistant and Inseminators (LFAI).

Semen collection, evaluation and preservation: Semen was collected by Artificial Vagina (AV) method. Artificial vagina was prepared appropriately having proper temperature (40-44°C), pressure and softness and semen was collected 5 to 6 times per month from each bull. The volume per ejaculate was recorded from the graduated collection vials after collection. Just immediately after collection the pH of the semen was estimated by using indicator paper stripes.

The concentration of spermatozoa per cubic milliliter for each ejaculate was measured by direct cell count method[6]. Semen, which contained more than 1000 million spermatozoa per ml was used for AI purpose otherwise discarded. Sperm motility, in initial, on dilution and post-thawing stages was assessed by microscopic examination and was recorded in percentage.

Semen with motility of more than 50% was diluted with the freezing extender of egg-yolk citrate glycerol. The diluted semen was subsequently loaded in 0.25 mL/ straw, cooled to 4°C and equilibrated for 4 h. Straws were frozen in freezer with a cooling rate of -60°C /min from +4 to -120°C. Loaded straws were then transferred to liquid nitrogen until subsequent evaluation or insemination.

Assessment of fertility: Fertility of bulls was estimated on the basis of Non Return Rate (NRR %) and NRR is defined as the number of cows, which are not represented for a subsequent insemination within 30 to 60 days[4]. In the present study the following formula has used to calculate the NRR:

$$\text{Non Return Rate} = \frac{\text{Number of served cows not requested further service within 30-day}}{\text{Total number of cows served}} \times 100$$

Statistical analyses: Collected data was analyzed using "MSTAT" computer program to compute analysis of variance (ANOVA) for Completely Randomized Design. Duncan's Multiple Range Test was performed to identify significant difference among the treatment means[7]. Correlation co-efficient was calculated among the different measurements using the computer program "MSTAT".

RESULTS AND DISCUSSION

The effect of individual bull on semen quality

Volume of semen: Semen volume differed significantly ($p<0.01$) among the bulls. The highest volume was obtained in bull B_4 followed by B_3, B_1, B_2 and B_5 in the order of 5.60±0.19, 4.19±0.19, 3.93±0.18, 3.40±0.19 and 2.76±0.27 mL, respectively. The moderate and almost similar volume of semen was found in B_1 and B_2 bulls, while the lowest volume of ejaculate was found in B_5 bull (2.76± 0.27 mL) (Table 1).

The five bulls were of same breed and age and their management was almost identical. The differences in semen volume among the bulls might be due to individual variation. Al-Hakim *et al.*[8] reported the significant ($p<0.01$) individual variation in semen volume of Karadi bulls. The difference in volume of semen might reflect their different genetic potentiality and genetically superior bulls could produce higher volumes of semen. The present study also agrees with the studies of Hoque *et al.*[9], Amstalden *et al.*[10] and Alexievn *et al.* [11].

Sperm motility: The highest initial motility was found in bull B_4 and the value (73.56±0.61%) was reached in significant level ($p<0.01$) than those of B_1 (70.69±0.58%)

Table 1: Semen volume, sperm motility and semen pH of five Sahiwal bulls

Parameters	Sahiwal bull B_1 (N=59)	B_2 (N=54)	B_3 (N=54)	B_4 (N=52)	B_5 (N=26)
Volume /ejaculate(mL)	3.93±0.18bc	3.40±0.19cd	4.19±0.19b	5.60±0.19a	2.76±0.27d
Sperm motility (%)-Initial	70.69±0.58b	73.09±0.60a	73.31±0.60a	73.56±0.61a	69.85±0.87b
-On dilution	65.00±0.31bc	65.02±0.32bc	66.02±0.32b	69.27±0.33a	64.62±0.46c
-Post-thawing	56.37±0.45bc	56.72±0.47b	57.46±0.47b	63.90±0.48a	54.65±0.68c
Semen pH	6.02±0.09	6.19±0.07	6.22±0.10	6.37±0.09	6.30±0.13

• Means with different superscripts within the same row differ significantly ($p<0.01$) from each other, • N indicates the number of observation.

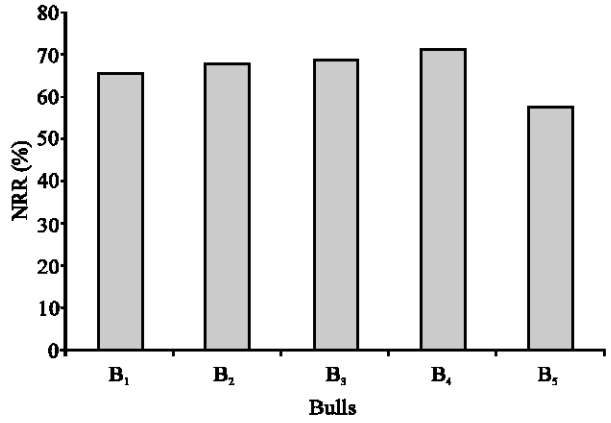

Fig. 1: Fertility on the basis of non-return rate (NRR %) of five Sahiwal bulls

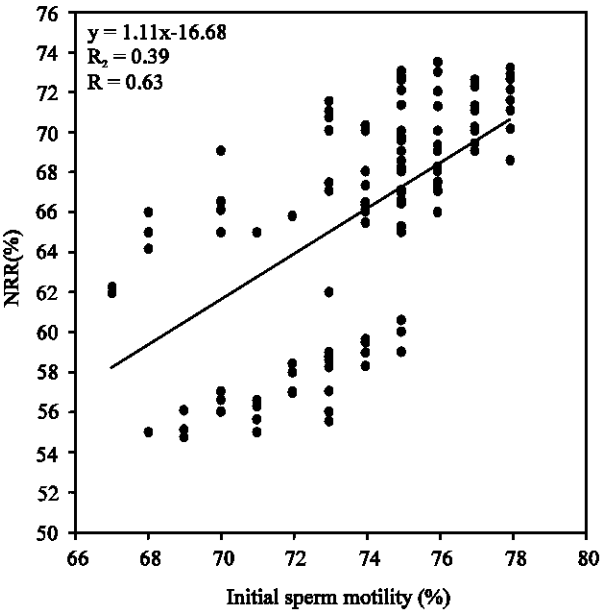

Fig. 2: Relationship between initial sperm motility (%) and non-return rate of Sahiwal bulls

and B_5 (69.85±0.87%) (Table 1). The analysis of variance revealed that the bull-to-bull variation was significant ($p<0.01$) in initial motility. This observation is in agreement with the previous studies of Hoque *et al.*[9], Amstalden *et al.*[10], Dhami and Kodagali[11].

On dilution and post-thawing motility showed significant ($p<0.01$) differences among the bulls and B_4 again was found as the best performer among the bulls in these two criteria. The dilution and post-thawing motility were not reached in initial level and the lowest level of motility was recorded in post-thawing group.

The individual variation in motility of spermatozoa suggests that this character may be taken into consideration while selecting bulls as because motility is said to have positive relationship with fertility[8].

Semen pH: While considering pH, no significant variation was found among the bulls (Table 1). But the highest pH was observed in B_4 (6.37±0.09) and the lowest in B_1 (6.02±0.09). The insignificant variations in semen pH among the bulls in the present study indicated the equal fitness of five bulls in terms of semen pH and this also corroborates well with the result of Dhami and Kodagali[12] in Surti buffalo bulls.

Among five bulls, B_4 was screened as the best performer on the basis of semen quality and this bull might have good genetic potentiality for quality semen production than others and deserves further study for confirmation.

Non Return Rate (NRR %) of different bulls: The data were analyzed statistically and the variation among the bulls was found to be significant ($p<0.01$) in most of the cases except between the B_2 (67.90±0.40%) and B_3 (68.61±0.35%) (Fig. 1). The highest NRR was obtained in bull B_4 (70.90±0.35%) followed by B_3 (68.61±0.35%), B_2 (67.90±0.40%), B_1 (65.80±0.35%) and B_5 (57.16±0.35%).

Fertility of bulls on the basis of NRR is one of the important criteria for evaluating the breeding bulls which fail to fertilize or do so inadequately are eliminated by selection[13]. The variation in fertility among the bulls found in the present study is more practical and might show the individual potentiality of each bull. Kuperschmied and Gaillared[14] observed that the NRR significantly affected by AI bull.

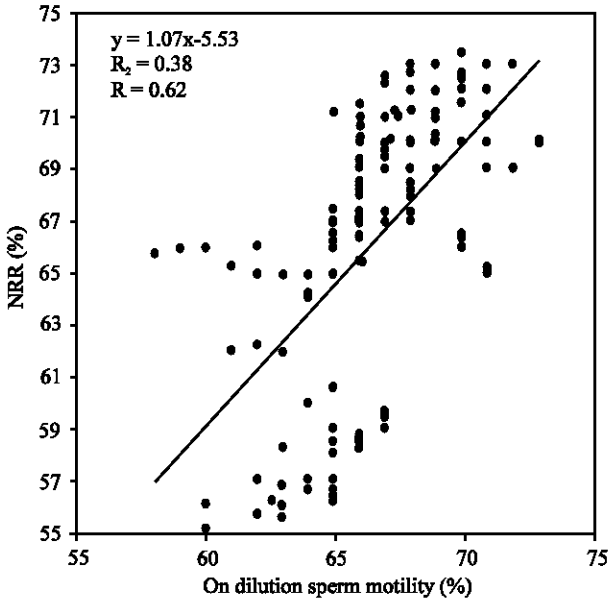

Fig. 3: Relationship between on dilution sperm motility (%) and non-return rate (NRR %) of Sahiwal bulls

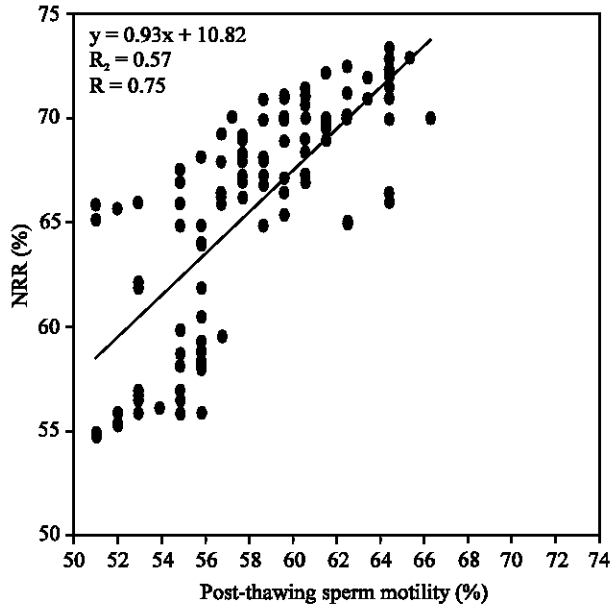

Fig. 4: Relationship between post-thawing sperm motility (%) and non-return (NRR %) of Sahiwal bulls

Correlations between sperm motility and non-return rate: The positive correlations were found in all three stages of sperm motility and fertility of bulls (B_1, B_2, B_3, B_4 and B_5). The former two relationships were found to be moderate (r=0.63 and 0.62) (Fig. 2 and 3) and the last one found highly correlated (r=0.75) (Fig. 4).

The results of the present study were supported by other researchers[15-17] and indicated that sperm motility is strongly associated with bull fertility and this might be considered as the selection criteria of breeding bulls. It implies that phenotypic selection for sperm motility in bull will result in a corresponding change in NRR.

It can be concluded from the present study that there is much variability in the potentiality of semen quality and fertility of bulls. Therefore, a response can be obtained from sire selection in a well-defined breed. The result of this study gives an important criterion for sire evaluation on the basis of semen quality and herd fertility.

ACKNOWLEDGMENT

The authors gratefully acknowledge the co-operation of Bangladesh Milk Producers' Co-operative Union Limited, Baghabarighat, Sirajgong in allowing access for the collection of data.

REFERENCES

1. Ahmed, Z. and T.H. Islam, 1987. Cattle breeding program through artificial insemination in Bangladesh. A Report from Central Cattle Breeding Station, Savar, Dhaka, Bangladesh.
2. Hoque, M.D., 1998. Phenotypic variation and repeatability of semen characteristics of purebred and crossbred bulls. M.Sc Thesis. BAU, Mymensingh, Bangladesh.
3. Hoque, M., 1968. Repeatability of semen characteristics of yearling beef bulls. Ani. Sci. J. East Pak., 5:34-38.
4. Willett, E.L. and G.W. Salisbury, 1942. The effect of various diluters, cooling rate, temperature of storage and some other factors on the livability of spermatozoa in stored samples of bull semen. Cornell University of Agril. Exp. Sta., pp: 249.
5. Hoque, M.A., M.R. Amin and M.S. Hussen, 1999. Dairy potential of pabna cows and crossbreeds with Sahiwal and Friesian and within and between breed sire effect. Asian-Aus. J. Ani. Sci., 12: 161-164.
6. Elliott, F.I., 1978. Semen Evaluation. In: Physiology of Reproduction and Artificial Insemination of Cattle. Eds., Salisbury, G.W., N.L. Vandemark and J.R.W.H. Lodge, Freeman and Com., Sanfrancisco, USA., pp: 450-427.
7. Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics (2nd Ed.). McGraw Hill Book Co., New York.
8. Al-Hakim, M.K., S.B.A. Ali and B.P. Singh, 1984. Study on semen characteristics of Karadi (Kurdi) bulls. Indian J. Ani. Health, 23: 163-169.

9. Hoque, M.A., M.R. Amin and M.S. Hussen, 1997. Breeding profiles of Sahiwal bulls and native cows in dairy pocket of Bangladesh. Bangladesh J. Ani. Sci., 26: 147-153.
10. Amstalden, M., E. Oba, J.E.P. Santos, A.A. Ramos and L. Franz, 1994. Studies of quantitative and qualitative characteristics of Bubaline Semen. Proceedings of the 4th World Buffalo Congress on 27-30 June, 1994 at Sao Paulo, Brazil, 3: 582-584.
11. Alexievn, A.I., S.I. Kolev, A.D. Danev and M. Stojanova, 1994. Characteristics of buffalo bull sperm production in Bulgaria. Proceedings of the 4th World Buffalo Congress on 27-30 June, 1994 at Sao Paulo, Brazil, 3: 492-494.
12. Dhami, A.J. and S.B. Kodagali, 1987. Seasonal variations in seminal characteristics of Surti buffalo bulls. Gujvet, 15: 1-7.
13. De Kruif, A., 1978. Factors influencing the fertility of a cattle population. J. Reprod. Fertil, 54: 507-518.
14. Kuperschmied, H. and C. Gaillard, 1981. Thawing time of cattle semen in ministraws and non-return rate. Schweizer-Archiv-fur-Tierheilkunde, 123: 515-522.
15. Christensen, P., P.B. Brockhoff, L.V. Borge and H. Lehn-Jensen, 2001. Semen research and domestic animal breeding 3: Semen quality and fertility of bulls and boars. Dansk-Veterinaertidsskrift, 84: 6-10.
16. Correa, J.R., M.M. Pace and P.M. Zavos, 1997. Relationship among frozen-thawed sperm characteristics assessed via the routine semen analysis, sperm functional tests and fertility of bulls in an artificial insemination program. Theriogenolgy, 48: 721-731.
17. Hahn, J., R.H. Foote and G.E. Seidel, 1969. Quality and freezability of semen from growing and aged dairy bulls. J. Dairy Sci., 52: 1843-1848.