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Effect of sexed semen on conception rate and sex ratio under field conditions

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Abstract
A study was undertaken in the Lohaghat block of Champawat district, Uttarakhand to assess the conception rate and sorting efficiency of sexed semen under field condition. Artificial Inseminated (AI) was done in 218 animals during the study period. Cows were divided in two groups G1 and G2 on the basis of use of sexed and unsexed semen, respectively for AI. In G1, total 70 cows inseminated with sexed semen from three centers of Lohaghat block and conception rate, female calves and male calves were 40%, 82.14% and 17.85%, respectively. Total 148 cows were inseminated with unsexed semen from the same three centers. The observed conception rate, female calves and male calves were 49.32%, 50.68% and 49.31%, respectively. Female calves and male calves% were significantly (P<0.01) higher and lower respectively with sexed compared to unsexed semen. The present study highlights the importance of using sexed semen under field condition to increase the milk yield and reduce the burden of male calves on the farmers.

Keywords: Sexed semen, Bovine, AI, conception rate, Sex ratio etc.

1. Introduction
Indian cow (*Bos indicus)* has significant contribution to the national economy as milk and manure [1]. According to 19th Livestock Census-2012, the total cattle and buffalo population in the country stands at 190.9 million and 108.7 million, respectively. India ranks first in milk production with 146.3 million tones which is 18.5 per cent of global production during 2014-15 [2]. Milk production in India has increased tremendously during the last four decades, from around 20 million tons in the 1960s to 116 million tons in 2010-11 due mainly to Operation Flood which emphasized introduction of improved breeding technology and germplasm, along with development of dairy cooperatives and horizontal integration of milk markets. Despite rapid strides made by the milk sector per animal productivity is very less as compared to the average in developed countries.

Increase production of commodities like milk, meat, wool, hide etc is only possible if animals of good genetic potential are reared. In this regard reproductive technologies are the most efficient strategy. These technologies have contributed significantly to the evolution of animal breeding in the last 60 years [3]. Reproductive technologies like Artificial insemination (AI), Multiple ovulation and embryo transfer (MOET), *In-vitro* embryo production (IVEP), Cloning and Transgenesis are being applied for genetic improvement. Artificial insemination (AI) is replacing natural service in bovines, on account of its ability to improve the genetic potential and ease of application under field conditions. Apart from improving the genetic potential it also helps in preventing the transmission of some venereal infectious diseases, like vibriosis and trichomonasis, brucellosis, tuberculosis and IBR that are usually spread through natural mating.

The cattle husbandry of modern India has shifted from those used for agricultural operations to animals specifically used for dairy purpose. Due to the use of cross-bred animals for breed improvement bulls cannot be used as draught animals. Also mechanization of agriculture leads to disuse of bulls for ploughing and other farm use. As per the estimates the contribution of the draft animals to the total energy requirements of the farming sector has reduced from the levels of 71% in 1961 to 23.3% in 1991 and is still declining. Also due to the limited availability of feed and fodder male calves add to the burden of the farmers. The cross-bred bulls pose a constraint for a planned breeding intervention in terms of indiscriminate crossing while grazing and transmission of venereal diseases, while also causing damage and loss to farmer

crops and a significant loss of feed resources. They also create problems for general disease control, as they do not undergo regular vaccination. Therefore, the solution of improving the genetic potential and thereby the milk production of India, while keeping the number of stray/ male animal at the minimum lies with the use of AI using sexed semen. The use of sex specific semen helps in the production of more number of female calves, decrease of calf mortality, due to neglect, or release into the village where they roam unattended.

Sexed semen is a new reproductive technology aimed to alter the sex ratio of the offspring toward a desired gender. About 90% of the new born will be from the required sex [4] by the use of this technology. Sexed semen was first used in the bovine population of UK at the start of the 21st century. The high cost and low conception rate are two factors which limit its usage especially in the developing countries [5]. Data from various studies show that the fertility of sexed semen is much lower than that of unsexed semen [6, 4, 7] adding to the difficulty in its field application.

This study was undertaken with the objective of creating awareness in the dairy farmers as to the importance of artificial insemination especially using sexed semen. Also this pilot study was done to access the conception rate and sorting efficiency of sexed semen under field conditions in the Lohaghat block of Champawat district.

2. Materials and method

2.1 Area of study

The project was undertaken on a pilot basis between June2015 to October 2015. The study was conducted in the Lohaghat block of Champawat district of Uttarakhand. Lohaghat is located at 29.42°N 80.10°E and 29.42°N 80.10°E at an altitude of 1706 meters. The town has an area of 4.5 km^2 and a population of 45,333 as per 2011 census. The breedable cattle population of the block is between 6000-7000 animals. Three hospitals of Logaghat block were identified for carrying out the study.

2.2. Semen

Frozen sexed semen (Flow cytometric sorted) and unsexed semen was obtained from the Uttarakhand Livestock Development Board (ULDB), Dehradun. The sexed semen straws were outsourced from ABS, Canada costing Rs.1300/-, but due to high cost compared to normal unsexed semen (Rs.100) farmers were not willing to participate in the study. Therefore the straws were supplied free of cost to the farmers under ATMA (Agriculture Technology Management Agency).

2.3 Animal selection

Dairy cows in their first and second calving, weighing between 300-400 kg from framers willing to participate in the study were selected. All heifers were examined per-rectally to exclude any genital tract anomalies. Heifers found suitable by examination were used in the study.

2.4 Artificial insemination and calving

Artificial Inseminated (AI) was done in 218 animals during the study period. Cows were divided in two groups G1 and G2 on the basis of use of sexed and unsexed semen respectively, for AI. Nearly 70 cattle identified as per the above mentioned criteria were artificially inseminated with sexed semen obtained from the ULDB, Uttarakhand on observation of estrus symptoms by the owner and further confirmed by per-rectal palpation. Animals were inseminated nearly 12-24 hrs after the reporting of estrus signs. The semen was deposited into the mid-cervix of the animals by trained inseminators. The data regarding unsexed semen (148 inseminations) was part of AI done in the same area during a similar period. The animals were examined per-rectally between 12-15 weeks after insemination to detect establishment of pregnancy in the animals.

2.5 Analysis of results

Data related to conception and final calving was recorded in all the 218 animals inseminated with sexed and unsexed semen. The sex of all the calves born in the study was also noted. The conception rate, percentage of male and female calves was calculated for both types of semen employed for insemination. Statistical analysis (t-test) of data and results was performed as per statistical procedure [8] by using the SPSS computer package.

3. Results and Discussion

In the present study animals in first and second calving were target as these give best results with sexed semen [4, 15]. The average conception rate of sexed semen was found to be 40% (35-46%) compared to 49.32% (48-52%) for the unsexed semen (Table 1). With regards to female percent, sexed semen produced nearly 82.14% (85.71-92.85%) female calves as compared to 50.68% (48-54.16%) for unsexed semen (Table 1). Female and male calves produced by using sexed semen were significantly (P<0.01) higher and lower respectively compared to unsexed semen. The calves born by using sexed semen are depicted in Figure1.

The present study was in accordance with the earlier studies where nearly 85-90% of desired sex calves born by sexed semen [4, 6, 10-14]. In a retrospective study in the USA [4], on the efficiency of sexed semen by using farm records it was found that the percentage of female calves was around 89%. The percentage of female calves born in a Danish [6] study varied from 89% to 93% among three breeds of cattle. The female calf percentage of 88% was reported following three inseminations in cattle that did not conceive the first time in Egypt [15].

Statistical analysis indicated the considerable influence of climate, semen type, inseminating sire, insemination year and season, and gestation length on the calf sex ratio. The herd effect did not have a significant effect on calf sex ratio. Some workers [12] have demonstrated that semen type, gestation length and inseminating sire are the main predictors of calf sex. Another study [16] reported greater incidence of male calf birth following periods of elevated temperature during the week prior to conception.

In the present study, conception rate was non-significantly higher in unsexed than sexed semen. This is in accordance with work in some previous studies [12, 17]. In the USA conception rates at first service averaged 47% for Holstein heifers and 53% for Jersey heifers, which were approximately 80% of that achieved with conventional semen [4]. In a study in Denmark [6] the conception rate using sorted semen was 5% points lower than with conventional unsexed doses for Danish Reds, 7% points for Jerseys, and 12% points for Holsteins. Further, a study [13] reported 55% conception rates for conventional and 44% for sexed semen. Another study on farm records in Australia [12] revealed 52% pregnancy rates for sexed semen and 58% for conventional semen. There occurred reduction of 4% to 38% in pregnancy rates in heifers, and 33% in postpartum cows on using sexed semen [18]. In a similar study on the fertility of commercially

available sexed semen in Egypt [15] calving rates of 29.3% and 51.1%; for sexed and unsexed semen, respectively was observed. This was relatively lower than that observed in our study. In contrast to present study conception rate of 69.7% (30/43) for sexed semen and 66.5% (1545/2325) for unsexed semen following AI was reported in China [19]. The probable reasons for the lower pregnancy/AI of females inseminated with sex-sorted semen may be attributed to their reduced lifespan in the uterus [20], reduced number of sorted sperm per straw [21, 22] and bull related fertility problems [22, 23, 24].

4. Conclusion

This study carried out on a small scale highlights the success of sexed semen under field condition in producing calves of the desired sex in high percentage. However, the present study did not consider the economics involved in use of sexed semen and its postulated benefit to farmers. This call for further larger studies targeting more number of animals with emphasis on the economic gain to farmers, so that the success of sexed semen under field conditioned in India can be established. The lower conception rate recorded for sexed semen seems to be a major drawback in its acceptance under Indian conditions, which can only be overcome by educating the farmers on its benefits.

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Table 1: Conception rate and sex ratio of sexed and unsexed semen under field condition (Lohaghat block, Champawat, Uttarakhand)

Semen type	Animals inseminated	Animals Conceived	Female calves	Male calves
Sexed Semen	70	28 (40%)	23 (82.14%)	5 (17.85%)
Unsexed	148	73 (49.32%)	37 (50.68%)	36 (49.31%)
t-value		2.3785	6.3650 **	6.3623 **

** Significant (P<0.01)

Fig 1: Calves produced from sexed semen in Lohaghat block, Champawat, Uttarakhand

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