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### Impact analysis of sexed sorted semen technology in field condition of Warangal district of Telangana state

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#### Abstract

**Background and Aim:** Recent advancements in sexed semen technologies, particularly in sorting techniques, have enhanced the ability to selectively determine the sex of offspring in cattle. This study, conducted by ICAR-KVK Mamnoon under PVNRTVU, served as a front-line demonstration in adopted villages of the Warangal and Hanmakonda districts in Telangana. It aimed to evaluate the conception rates and sorting efficiency of sexed semen in comparison to conventional semen (CS) under field conditions.

**Materials and Methods:** In this study, artificial insemination was conducted using sex-sorted semen (SS; n = 200) and conventional semen (CS; n = 200) during spontaneous estrus, precisely 16 to 18 hours after the onset of estrus signs. The objective was to compare conception rates in crossbred cows under field conditions. Several parameters were recorded for each cow, including the percentage of conception rates and the number of female and male calves born.

**Results:** Conception rates for sex-sorted semen and conventional semen were recorded at 55% and 53%, respectively, indicating a statistically significant difference ( $p < 0.01$ ). The percentages of female and male calves born from sex-sorted and conventional semen were 89% and 73%, respectively, with sexed semen showing a significantly higher percentage ( $p < 0.01$ ) compared to conventional semen.

**Conclusion:** The number of female calves born and the conception rate were greater with sexed semen (SS) than with conventional semen (CS), with the duration of estrus being a significant factor affecting conception under field conditions. This study highlights the advantages of utilizing sexed semen in field settings to boost the number of female calves and reduce the burden of male calves for farmers.

**Keywords:** Sexed sorted semen, female calves, bovine, AI, conception rate, sex ratio etc.

#### 1. Introduction

In India, modern cattle husbandry has evolved from relying on animals mainly for agricultural purposes to prioritizing dairy production. The introduction of cross-bred animals for breed improvement has diminished the need for bulls as draught animals. Over the past decade, India's milk production has experienced significant growth, achieving a Compound Annual Growth Rate (CAGR) of 6%. This rise is evident as production increased from 187.30 million tonnes in 2018-19 to 230.58 million tonnes in 2022-23. The increasing mechanization of agriculture has further reduced the need for bulls in ploughing and other farm activities. Today, it is estimated that India has around 70 million draught animals, which till about 65% of the country's cultivated land, equivalent to 18 million kW. Moreover, the limited availability of feed and fodder for male calves poses

an additional strain on farmers, making it a significant challenge. Consequently, a feasible solution to improve the genetic potential and milk production in India, while minimizing the population of stray and surplus male animals, lies in the adoption of artificial insemination using sexed semen.

The use of sex-sorted semen encourages the production of more female calves and decreases calf mortality associated with the neglect or abandonment of male calves in villages. This groundbreaking reproductive technology aims to alter the offspring's sex ratio toward a desired gender, achieving approximately 90% of newborns being the preferred sex when applied [8]. Sexed semen was first introduced to the bovine population in the UK at the start of the 21st century. However, research shows that the fertility rates of sexed semen are significantly lower compared to unsexed semen,

which poses challenges for its practical application in the field [4, 8, 12, 24]. Sperm sexing is an essential reproductive technology that affects the sex ratio of offspring within the dairy sector [19]. In India, the utilization of sexed semen (SS) has gained importance in field conditions, especially given the limited growth of dairy herds and the presence of progressive farmers [3]. One of the main benefits of using SS is the increased birth rate of female calves, which typically ranges from 70% to 80% and can occasionally reach up to 90% [7]. This significantly boosts the profitability of dairy operations by ensuring a sufficient supply of heifers for lactation [26].

However, sexed semen (SS) exhibits lower efficacy due to a decreased concentration of spermatozoa compared to conventional semen (CS). As a result, the likelihood of conception in heifers [14] and cows [18] through artificial insemination (AI) using SS is roughly 70-80% of that achieved with CS, which is significantly higher. To effectively utilize SS, careful selection of cows is also necessary. This study, conducted by ICAR-KVK Mamnour, under PVNRTVU served as a front-line demonstration in the adopted villages of Warangal and Hanmkonda districts in Telangana. Its objectives were to evaluate the conception rates and sorting efficiency of sexed semen in relation to conventional semen, as well as to raise awareness among dairy farmers about the significance of artificial insemination, particularly the benefits of using sexed semen.

## 2. Materials and Methods

**2.1 Study period and location:** The research was carried out by Krishi Vigyan Kendra Mamnour through Front Line Demonstration (FLD) from 2021 to 2023 in the adopted villages of Warangal and Hanmkonda districts in Telangana.

**2.2 Sex sorted semen:** Sex-sorted semen of Sahiwal KARIM bull (SSS) was procured from BAIF, Pune, at a cost of ₹800. However, due to its high price compared to conventional unsexed semen (₹100), farmers were hesitant to participate in the study. To encourage their involvement, the straws were provided free of charge under the Front Line Demonstration (FLD) program.

**2.3 Experimental animals and design:** The study population included healthy crossbred cows in their second and third calving, weighing between 300-400 kg, selected from farmers willing to participate. These cows were reared in a loose housing system and fed three times daily. The experiment aimed to assess the efficacy of sexed semen (SS, n = 200) and conventional semen (CS, n = 200) during spontaneous estrus under field conditions. Dairy cows underwent per-rectal examinations to rule out any genital tract anomalies and those deemed suitable were included in the study.

**2.4 Artificial insemination and calving:** Artificial insemination with sexed semen (SS) and conventional semen (CS) was conducted in cows 16-18 hours after the onset of visible estrus signs, confirmed by clear genital discharges and per-rectal palpation. Trained inseminators deposited the semen into the mid-cervix of the animals.

**2.5 Pregnancy outcome:** After insemination, the animals

were examined per rectally using ultrasound with a 5-7.5 MHz linear probe for the first 32 to 45 days of pregnancy. Following this, rectal palpation was conducted at 75 days post-insemination to check for signs of pregnancy. The sex of the newborn calf was recorded at the time of calving.

**2.6 Analysis of results:** Data on conception and final calving were collected for all animals inseminated with sexed and unsexed semen. The sex of all calves born during the study was also recorded. The conception rate, along with the percentage of male and female calves, was calculated for both types of semen used. Statistical analysis (t-test) was conducted using the SPSS software, following standard statistical procedures.

## 3. Results and Discussion

In this study, animals in their second and third calving were targeted, as they yield the best results with sexed semen. The average conception rate for sexed semen was 55%, compared to 53% for unsexed semen. Regarding female calves, sexed semen produced approximately 89% females, while unsexed semen produced 73% (Table 1 & 2). The number of female calves from sexed semen was significantly higher ( $p < 0.01$ ), while the number of male calves was significantly lower compared to unsexed semen. The results obtained are mentioned in the Table 1 & 2. Distribution of sexed semen, insemination, USG detection and calves born from sexed semen were depicted in the figures 1-4.

In the present study, it was found that 89% of the calves born from sexed semen were female, which contrasts with the 50% to 52% reported by [11, 24]. These differences may be attributed to variations in environmental conditions or artificial insemination methods. [24] reported female calves at 87%, while [25, 11, 6] reported rates of 85.1%, 89%, and 86%, respectively, with sexed semen, which aligns with our findings. In contrast, the conception rates for conventional semen were 54.8% and 45.2% differing from our results. The results from our study align with the percentage of female calves born in a study mentioned by [6], which ranged from 89% to 93% in crossbred cows. The present study is consistent with [4, 6, 10-14] who found that nearly 85-90% of desired sex calves were born from sexed semen. A retrospective study by [4] reported that the efficiency of sexed semen resulted in approximately 89% female calves, which is similar to our findings. In the present study, the conception rate for sexed semen was significantly higher than that for unsorted semen, which contrasts with findings obtained by [12, 17].

A study done by [4] revealed that the conception rate using sorted semen was 5 percentage points lower for Danish Reds, 7 percentage points lower for Jerseys, and 12 percentage points lower for Holsteins compared to conventional unsexed doses which differs from the findings in the present study.

Furthermore, a study [13] reported conception rates of 55% for conventional semen and 44% for sexed semen, which aligns with our findings. In contrast, another study based on farm records by [14] revealed pregnancy rates of 52% for sexed semen and 58% for conventional semen, which differs from the results of the present study.

In a similar study on commercially available sexed semen

by [1] mentioned that calving rates as 29.3% for sexed semen and 51.1% for unsexed semen, which are relatively lower than those found in our study. In contrast, a study performed by [16] reported conception rates of 69.7% for sexed semen and 66.5% for unsexed semen following artificial insemination. The lower pregnancy rates for females inseminated with sex-sorted semen may be attributed to factors such as reduced uterine lifespan [20], a lower number of sorted sperm per straw [8, 23], and bull-related fertility issues [8,13, 22].

A study conducted by [27] reported that male calf rates in the sexed and conventional semen groups ranged from 12% to 45.2% and female calf rates ranged from 88.0% to 54.8%,

respectively which is similar to our studies.

The average conception rate of sexed semen was found to be 40% (35-46%) compared to 49.32% (48-52%) for the unsexed semen [28] which is contrast with the present study which obtained 55% and 53% with sexed and unsexed semen. 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 which is also lesser when compared with our study.

In contrast to our study conception rate of sexed semen by [29] was found to be 39.53% which is 55% in our study, female calves obtained were 86.15% where 89% was reported in our study.

**Table 1:** % of Conception, No of females and males obtained with sexed and unsexed semen under field condition

Sl. No	Year	Sexed Semen					Unsexed Semen				
		Straws distributed	No of animals conceived	% of conception	No of female calves born	No of male calves born	Straws distributed	No of animals conceived	% of conception	No of female calves born	No of male calves born
1	2020-2021	100	51	51	43	5	100	52	52	35	14
2	2021-2022	50	28	56	25	3	50	26	52	18	5
3	2022-2023	50	29	58	26	3	50	28	56	20	8

**Table 2:** Pooled data of three years (2020-2021, 2021-2022,2022-2023)

SL. No	Parameters	No of animals conceived	% of conception	Total Calves produced	No of Female calves born	No of male calves born
1	Sexed Semen (n=200)	108	55	105	94(89.5%)	11(10.5%)
2	Unsexed Semen (n=200)	106	53	100	73(73%)	27(27%)
	t-Value		2.1318		5.1573 **	5.4610 **

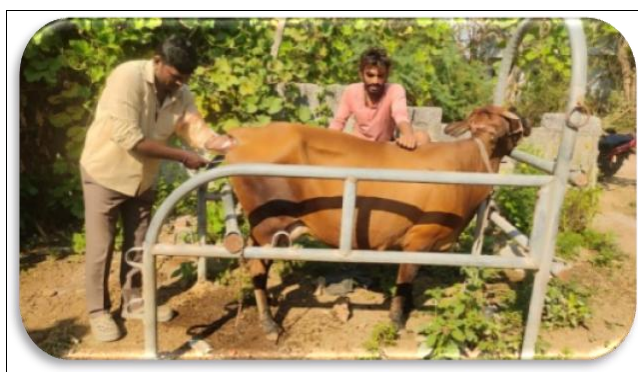
\*\* Significant ( $p < 0.001$ )



**Fig 1:** Distribution of Sex Sorted Semen by KVK Mamnoor



**Fig 3:** Pregnancy diagnosis by KVK scientists



**Fig 2:** Insemination with Sex Sorted Semen by Veterinary Assistant Surgeons



**Fig 4:** Female calves born with sexed semen

**Conclusion**

Sexed semen (SS) increased the number of female calves for dairy farmers by improving reproductive efficiency and enabling gender-based herd management in crossbred cows. By the conclusion of the study, it was shown that SS attained a conception rate comparable to that of conventional semen (CS). This small-scale study underscores the effectiveness of sexed semen in field



conditions for producing a high percentage of desired-sex calves. In the current agricultural landscape, sex-sorted semen is crucial for farmers, as it accelerates the production of replacement heifers, reduces dependence on purchasing heifers, decreases the number of male calves, boosts milk production, optimizes limited feed and fodder resources, supports climate change mitigation and facilitates the production of bulls and daughters for progeny testing.

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