



Effectiveness and Performance of “Sexcel” - ABS Sexed Semen, in Dairy Heifers, Cows and Buffaloes in Field conditions in different Agro-Climatic Zones of India

Tushar Sharma^{1*}, Rahul Gupta¹, Arvind Gautam¹, Prashant Giram¹ and Jyotsana Madan²

¹Genus Breeding India Pvt. Ltd., Pune, Maharashtra, INDIA

²Department of Veterinary Physiology and Biochemistry, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, INDIA

*Corresponding author: T Sharma; Email: tushar.sharma@genusplc.com

Received: 27 March, 2019

Revised: 23 July, 2019

Accepted: 26 July, 2019

ABSTRACT

To analyse the effect of sexed semen on different breeds used in artificial insemination following study was conducted using sexed semen from seven different breeds for artificial insemination in females. All bulls used for sexing by ABS India were genomically tested for Holstein and Jersey breeds. A total of 3034 inseminations with Sexcel were performed with 2589 inseminations in dairy cows and 445 in buffaloes. The conception rate of sexed semen using confirmative pregnancy diagnosis (using peri rectal examination) at 90 days post insemination both in cows and buffaloes was recorded. Sex of the calf was recorded after the birth in each case. The results of conception rate (CR) and pregnancy rate evaluation in different breeds were recorded. The results revealed the average conception rate of Sexcel semen is 49.1% (ranging from 45.1 to 55.3%) in cows and 42.7 % in buffaloes. These figures show a cumulative picture wherein sexed semen was used in animals of different parities (Both primiparous and pluriparous). The current study provides ample insights into the conception rate using sexed semen under various agro climatic conditions in different breeds. The study showed that sexed semen gives good conception in animals of one to three parities provided they are reproductively clean and possess good fertility.

Keywords: Sexed semen, Conception rate (CR), Farm Animals, Economics, Sexcel-ABS

The goal of using sexed semen is to produce a calf of a specific gender. It is almost 30 years since the first use of sexed semen was reported in the U.S. The technology has progressed considerably since then several organizations and researchers collaborating to eventually bring this to reality. The technical challenges limited the use of the sexed semen to heifers in the early years, but the usage spread to cows of different parity in the later years with reasonable amount of success. Comparing fertility of sexed semen with conventional semen has been a concern of the industry but the gap appears to have been substantially reduced due to latest cutting-edge technologies. The introduction of sexed semen was done by US commercial organizations in 2005 (Cassel, 2005; DeJarnette *et al.*, 2009).

Sexed semen is produced in India for the first time under the brand name “Sexcel” in 2017 by ABS India using

their proprietary IntelliGen technology. Not only is the semen sexed for Holstein and Jersey breeds but also from Indigenous breeds like Sahiwal, Gir, Red Sindhi, Crossbreds and Kankrej as well as Murrah and Mehsana breeds of buffaloes. Use of best genetic material to produce sexed semen ensures that the farmer receives a genetically superior calf on all occasions. This gives an opportunity for rapid genetic improvement, more milk production and less replacement cost to the farmer. Use of frozen semen whether conventional or sexed for artificial insemination is characterized by breeding year, parity, service number, region, herd size, and herd milk yield. Sexed semen is being used in about 9 % of all reported breeding in the

How to cite this article: Sharma, T., Gupta, R., Gautam, A., Giram, P. and Madan, J. (2019). Effectiveness and performance of “Sexcel” - ABS sexed semen, in dairy heifers, cows and buffaloes in field conditions in different agro-climatic zones of India. *J. Anim. Res.*, 9(4): 01-06.



year 2017 on the globe and is showing a double-digit growth in usage YOY (year on year).

Sexed semen is mostly preferred for heifers followed by first and second parity and not for later breeding of cows. However, the economic benefits vary between dairy farm. This fact sheet summarizes the field trials of sexed semen used in different dairy herds in heifers and cows. Further, the economics of the use of sexed semen in heifers and cows has been evaluated.

Objective

The primary objective to undertake the field study of Sexcel, was to know the effectiveness and performance in terms of conception rate and gender skew field conditions in India, covering various agro-climatic zones across different breeds of cattle and buffaloes. This study is unique as perhaps for the first time as many breeds have been included in sexed semen study that runs across all kinds of weather conditions— cold, hot and humid from North to South India

MATERIALS AND METHODS

The study was conducted covering a period of six months from June 2017 to December 2017. Sexed semen of seven different breeds was used in randomly selected farms in seven states of North, Central and South India. Active breeding bulls with marketed sexed semen from ABS were superior to average active AI bulls for evaluations of yield traits, somatic cell score, productive life, daughter pregnancy rate, service-sire calving ease, service-sire stillbirth, final score, sire conception rate, and lifetime net merit. All such bulls used for sexing by ABS India were genomically tested for Holstein and Jersey breeds.

A total of 3034 inseminations with Sexcel straws were performed with 2589 inseminations in dairy cows and 445 in buffaloes (Table 1).

The cows selected were within the age group of 2 to 5 years and buffaloes were 4 to 7 years old. All the animals were inseminated artificially using the sexed semen provided by ABS. The users were asked to retain the empty straw to validate the test results. Only those farms and households having holding of 5 and more animals identified using an ear tag were selected. At first baseline survey was conducted on 43 dairy farms/ dairy households. These

farms /households were spread across the states of Uttar Pradesh, Punjab and Haryana in North India, Maharashtra in Central India and Karnataka and Tamil Nadu in South India. In the trial, information of the farm, AI technician, semen used, cow inseminated and other AI related services were recorded on the day of AI conduct. All data was collected through a structured questionnaire. Factors related with health status of cows, farm management and conception rate using conventional semen at the farm/ household was also considered during data collection.

Three types of farm were selected for this study viz type A farm, type B farm and type C farm. According to the trial, type A farm consists of 5 cows, type B consisted 6 - 50 cows and type C consisted more than 50 cows.

In sexed semen the fractions of X-bearing (female) and Y-bearing (male) sperm have been modified from the natural mix through sexing and selection. Sexing is based on cell selective selection based on DNA content of sperm (Weigel, 2004; Seidel, 2007). This method is based on staining sperm DNA by fluorescent stain as the bovine Y chromosome differs from X chromosome by 3.8%. The latest technique from ABS is laser based and is claimed to be gentler on cells with no high electric current, high voltage or high pressure being used on cells. For Insemination 0.25 mL French mini straws of sexed deep-frozen semen were used which were stored in the in liquid nitrogen (-196°C) in cryocan.

The conception rate of sexed semen using confirmative pregnancy diagnosis (using peri rectal examination) at 90 days post insemination both in cows and buffaloes was recorded. Sex of the calf was recorded after the birth in each case. Data was analyzed by using the statistical analytical software (SAS, 2008).

RESULTS AND DISCUSSION

The results of conception rate (CR) and pregnancy rate evaluation in different breeds have been presented in table 1 and 2 respectively. The results revealed the average conception rate of Sexcel semen is 49.1% (ranging from 45.1 to 55.3%) in cows and 42.7 % in buffaloes. These figures show a cumulative picture wherein sexed semen was used in animals of different parities (Both primiparous and pluriparous), in different geographies and in different seasons (June to December). Current data set does not

Table 1: Conception rate (CR) evaluation on insemination of sexed semen in different breeds of cattle and buffalo

Breed	Inseminations	Confirmed pregnancies	CR I	CR II	CR (I&II Service)	Calves Born	Male	Female	Female skew %
Holstein	1070	570	55.9	50.7	53.3	569	45	524	92.09%
Jersey	464	223	52.1	44.1	48.1	223	19	204	91.48%
Sahiwal	405	201	54.6	44.6	49.6	199	23	176	88.44%
Crossbred	366	175	51.2	44.4	47.8	174	14	160	91.95%
Red Sindhi	100	47	50	44	47	47	5	42	89.36%
Gir	184	83	52.2	38	45.1	83	7	76	91.57%
Murrah	445	190	45.7	39.7	42.7	190	20	170	89.47%
Total	3034	1489	—	—	49.1	1485	133	1352	91.04%

Table 2: Pregnancies of sexed semen on animals of different parity

Breed	Total Inseminations	Confirmed pregnancies	Pregnancy in heifers	Pregnancy in animals in first parity	Pregnancy in animals in second parity	Pregnancy in animals in third parity
Holstein	1070	570	119	237	183	31
Jersey	464	223	36	126	61	0
Sahiwal	405	201	4	91	32	74
Crossbred	366	175	48	56	38	33
Red Sindhi	100	47	0	16	25	06
Gir	184	83	3	37	26	17
Murrah	445	190	49	52	38	51
Total	3034	1489	259	615	403	212

show any significant deviation in fertility of sexed semen when used in heifers and animals between first to third parity.

Sexed semen fertility in heifers

Various dairy breeders have tried to control the sex of the calf at conception for centuries (Garner and Seidel, 2008). Many field studies involving dairy cattle (Seidel and Schenk, 2002; Seidel, 2003; DeJarnette *et al.*, 2009) have reported up to 89% female offspring been achieved by sexed semen.

Successful use of sexed sperm requires proper management of cattle and farm, careful handling of sperm and use of a skilled AI technician (Seidel, 2007). Conception rate with sexed semen is directly proportional to reproductive efficiency, and as the reproductive management deteriorates conception rate also lowers. Sexed semen will not prove

much useful in farm having below par conception rate, in these cases primary focus should be to first take remedial measures to bring the reproductive efficiency up to average level. The random farms selected in this study had average conception rate of about 55% using conventional semen and satisfactory CR was achieved using sexed semen when other concerns regarding feeding and management are well addressed. CR using conventional semen in the same farms is given in table 3.

It is very difficult to get unbiased field comparisons of sexed sperm with conventional sperm due to likely bias in semen use (DeJarnette *et al.*, 2008, De Vries, 2009) but it appears that both farmers as well as technicians follow due diligence when using sexed semen due to its high cost (20-50 X) Dairy producers not only use to hand pick the most fertile animals for use of sexed semen but also followed the prescribed SOP's to get better result.

**Table 3:** Pregnancies of conventional semen on animals of different parity

Breed	Inseminations	Confirmed pregnancies	CR I	CR II	CR (I&II Service)
Holstein	1239	691	58.9	52.7	55.8
Jersey	432	239	60.1	54.8	57.45
Sahiwal	396	218	58.3	52.1	55.2
Crossbred	328	181	59.5	50.8	55.15
Red Sindhi	82	46	59.7	53	56.35
Gir	231	133	59.1	51.1	55.1
Murrah	403	187	48.1	45.2	46.65
Total	3111	1695			49.1

Sexed semen fertility in cows

From the recent studies, it was observed that successful use of sexed sperm in dairy cows, with satisfactory conception rate was achieved with cows that were selected with clean reproductive status prior to insemination. The insemination was restricted to heifers and cows between first to third parity.

AI with low sperm numbers is increasing widely to enhance the benefit from elite bulls and to provide enough scope for broader application of sexed semen. Requirement of higher milk productivity per cow and high replacement cost is thought to increase with the commercial application of sexed semen. More female calves can be obtained from elite dairy cows, and genetic value of the cows can be improved in short span of time by using sexed semen. As only 25 % of breedable animals in a dairy farm are heifers hence its use in cows cannot be avoided, especially for India where male calf is a huge issue and economic burden (Harris, 1966).

The number of spermatozoa per AI that is needed to obtain acceptable fertility results is crucial to the AI industry (De Vries *et al.*, 2006 and De Vries, 2009). The goal is to optimize the use of top bulls by maximizing the total output of sperm and the number of spermatozoa per AI, thus inseminating as many cows as possible without lowering the pregnancy rate. The minimum number of cells in a conventional semen straw recommended under the Minimum standard protocol circulated by the Ministry of Agriculture, Govt of India is 20 Million whereas the similar straws being imported into India contain 12 – 15 Million cells as the optimum number required to impregnate a cow.

Economic considerations

Calf prices

The value of sexed semen comes primarily from a much greater chance of getting a female calf than a male calf. Where bull calves may be worth NIL (Instead it costs an average ₹ 15,000.00 to rear a male calf), heifer calves may be worth ₹ 30,000.00 – 50,000.00. A farmer can purchase a heifer for ₹ 30,000.00-50,000.00 but raise his/her own heifer calf for ₹ 15,000.00. This assumes more significance as the externally purchase may be a potential hazard in contrast to a self-grown heifer (Poor /Unknown genetics, threat to biosecurity, additional cost, etc.). The cost paid for a newly purchased heifer is mostly non-budgeted and hence makes a huge dent on the farm profitability. The risk of a non-fertile heifer due to any reason decreases the price further. Economic benefits of sexed semen usage in producing female calves have been explored in numerous studies. In an early projection, Van Vleck (1981) estimated that sexed semen use could be profitable at a maximum cost of \$19 per unit based on a price of \$6 per unit for conventional semen; he also estimated that the rate of genetic progress could increase by 15% with widespread use of sexed semen. Seidel (2003) concluded that generally a premium of ≤\$10 for sexed semen with near normal fertility would be needed to achieve widespread economic usefulness and pointed out that profitability would greatly change with the changes in dairy sector. Another potential of using sexed semen is that its use may increase to solve a shortage of replacement dairy heifers but may decrease once the shortage is corrected. Such conditions usually follow increase in producer milk prices. Sexed semen use also can help to avoid biosecurity

problems from purchasing replacements outside the herd (Weigel, 2004). Ettema *et al.* (2004) modeled use of sexed semen for Danish industry conditions and concluded that profitable application of sexed semen was possible. However, market price of replacement animals would be affected, which directly affects the profitability from sexed semen use. Abdel-Azim and Schnell (2007) simulated use of sexed semen in a US Holstein commercial herd over 20 years and reported a large genetic advantage from its use. Relative genetic superiority of first-parity cows would increase to >30% in year 11 but then decline to 9% in year 20. DeVries *et al.* (2008) explored the results of sexed semen use on the US dairy industry. It was proposed that replacement heifers should only be obtained from only genetically superior dams. They reported that sexed semen use was expected to increase the rate of genetic progress (but not >15%) as well as the supply of herd replacements to where current demand was exceeded, and replacement prices were lowered. The long-term predictions were accelerated herd expansions, increased milk supply, lower milk prices, and lower production costs.

Incidence of Dystocia

Few studies have examined the differences in dystocia and stillbirth incidence for dairy cattle when female and male calves are produced from conventional and sexed semen. In a study to examine dystocia incidence Weigel (2004) and Fetrow *et al.* (2007) reported that the higher frequency of female calves from sexed semen and consequently smaller calf size would be expected to reduce the incidence of dystocia, especially for nulliparous heifers. Tubman *et al.* (2004) reported least squares means for calving ease scored from 1 (no assistance) to 4 (delivery by caesarian section) of 1.15 for female calves and 1.30 for male calves based on trials with mostly beef heifers and cows; differences between least squares means for conventional and sexed semen (1.23 and 1.22, respectively) were not significant ($P = 0.87$).

They also reported non-significantly different ($P > 0.10$) neonatal death (born dead or died within 24 h of birth) rates of 4.0 and 3.5% for conventional and sexed semen, respectively, and 4.5 and 3.0% for female and male calves. For a Danish field trial with Holstein heifers, Borchersen and Peacock (2009) reported stillbirth (born dead or died within 24 h) rates of 10% for female calves and 14% for male calves from sexed semen breedings compared

with 12 and 20% from conventional semen. DeJarnette *et al.* (2009) found that mean incidence of stillbirths for Holstein heifers with female calves was 9.2% for sexed semen breedings and 10.5% for conventional semen. They reported that herd, calving season within herd, and sire within semen type (sexed or conventional) influenced stillbirth; they also noted a higher incidence of stillbirths when male calves were born from a 90% X-sorted sperm population (20% compared with 13% for conventional semen) and speculated that this possibly resulted from the sorting process selecting aneuploid Y-bearing sperm. Herd, calving season within herd, calving age, sire within semen type, and interaction of semen type and calving age all affected the stillbirth rate for Holstein heifers with male calves.

According to Seidel (2014) sexed semen could be profitable on the genetically better animals while it is not profitable on the genetically poorer animals. If genetic progress is not considered, sexed semen is profitable when the value of the heifer calf is generally at least \$400 more than the value of the bull calf.

The study suggests that the sexed semen can provide satisfactory conception rate even after having low sperm number as compared to conventional semen and the advantages using sexed semen far outweigh other shortcomings like marginally less CR.

CONCLUSION

The current study provides insights into the conception rate using sexed semen under various agro-climatic conditions in different breeds. The study showed that sexed semen gives good conception in animals of one to three parities provided they are reproductively clean and possess good fertility. The results also opined that sexed semen is the best option available to farmers to generate replacements looking into the techno economics of sexed semen usage. There was almost consistent CR of sexed semen when it was used in different geographic regions with comparatively less in summer and higher in winter season.

REFERENCES

- Abdel-Azim, G. and Schnell, S. 2007. Genetic impacts of using female-sorted semen in commercial and nucleus herds. *J. Dairy Sci.*, **90**(3): 1554-1563.



- Anonymous. 2008. They use sexed semen (57th Hoard's dairyman round table). *Hoard's Dairyman*, 25: 56.
- Borchersen, S. and Peacock, M. 2009. Danish AI field data with sexed semen. *Theriogenology*, **71**(1): 59-63.
- Cassell, B. 2005. Does sexed semen have a role in your breeding program. *Hoard's Dairyman*, **150**: 396.
- De Vries, A. 2009. The economics of sexed semen in dairy heifers and cows. The Institute of Food and Science.
- De Vries, A., Overton, M., Fetrow, J., Leslie, K., Eicker, S. and Rogers, G. 2008. Exploring the impact of sexed semen on the structure of the dairy industry. *J. Dairy Sci.*, **91**(2): 847-856.
- DeJarnette, J.M., Nebel, R.L. and Marshall, C.E. 2009. Evaluating the success of sex-sorted semen in US dairy herds from on farm records. *Theriogenology*, **71**(1): 49-58.
- DeJarnette, J.M., Nebel, R.L., Marshall, C.E., Moreno, J.F., McCleary, C.R. and Lenz, R.W. 2008. Effect of sex-sorted sperm dosage on conception rates in Holstein heifers and lactating cows. *J. Dairy Sci.*, **91**(5): 1778-1785.
- Ettema, J.F. and Santos, J.E.P. 2004. Impact of age at calving on lactation, reproduction, health, and income in first-parity Holsteins on commercial farms. *J Dairy Sci.*, **87**(8): 2730-2742.
- Fetrow, J., Overton, M. and Eicker, S. 2007. Sexed semen: economics of a new technology. 24 pages in: Proceedings Western Dairy Herd Management Conference, Reno, NV, March 7-9.
- Garner, D.L. and Seidel Jr, G. E. 2008. History of commercializing sexed semen for cattle. *Theriogenology*, **69**(7): 886-895.
- Harris, M., Bose, N.K., Klass, M., Mencher, J.P., Oberg, K., Opler, M.K., Suttles W.A. and Vayda, A.P. 1966. The cultural ecology of India's sacred cattle. *Current Anthropology*, **7**(1): 51-66.
- Seidel Jr, G.E. 2003. Economics of selecting for sex: the most important genetic trait. *Theriogenology*, **59**(2): 585-598.
- Seidel Jr, G.E. 2007. Overview of sexing sperm. *Theriogenology*, **68**(3): 443-446.
- Seidel, G.E. 2014. Update on sexed semen technology in cattle. *Animal*, **8**(s1): 160-164.
- Tubman, L.M., Brink, Z., Suh, T.K. and Seidel Jr, G.E. 2004. Characteristics of calves produced with sperm sexed by flow cytometry/cell sorting. *J. Anim. Sci.*, **82**(4): 1029-1036.
- Van Vleck, L.D. 1981. Potential genetic impact of artificial insemination, sex selection, embryo transfer, cloning, and selfing in dairy cattle. *New technologies in animal breeding (USA)*.
- Weigel, K.A. 2004. Exploring the role of sexed semen in dairy production systems. *J. Dairy Sci.*, **87**: E120-E130.