Veterinary World, EISSN: 2231-0916
Available at www.veterinaryworld.org/Vol.6/Sept-2013/13.pdf

RESEARCH ARTICLE
Open Access

Artificial insemination in swine in an organized farm – A pilot study

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Received: 13-02-2013, Revised: 08-04-2013, Accepted: 10-04-2013, Published online: 05-07-2013

How to cite this article:
Ronald BSM, Jawahar TP, Gnanaraj PT and Sivakumar T (2013) Artificial insemination in swine in an organized farm – A pilot study, *Vet World* 6(9): 651-654, doi: 10.14202/vetworld.2013.651-654

Abstract

Aim: To assess the reproductive performance and managemental advantages of Artificial Insemination of swine.

Materials and Methods: Large White Yorkshire sows were grouped into two batches (10 each) for AI and natural mating. AI group was given two inseminations with semen extended with Beltsville Thawing Solution (BTS,3 x 10^9 spermatozoa per dose), at standing heat. Similarly, for natural mating group, triple mating was followed. The reproductive performance was studied after maintaining the sows under optimal managemental conditions.

Results: The results indicated that AI and natural mating practices showed 100% conception rate. The litter size of AI group was 8.36±0.28 and that of the natural mating group was 10.6±0.64, that varied with high significance. The still birth rate was 0.7±0.26, which was significantly higher in natural mating group. The pre-weaning mortality was 4.34% and 7.5% for AI group and natural mating group respectively. The time consumed during mating per sow also varied highly significantly which was 11.46±0.47 minutes and 51.2±2.08 minutes for the AI group and natural mating group respectively.

Conclusion: It was found that AI was found to be time and labor saving. The reduced litter size in AI group could be improved by ensuring that inseminations occur at an optimum time resulting in a high farrowing rate and litter size. AI can be successfully introduced in field conditions with some fine tuning.

Keywords: artificial insemination, conception rate, litter size, mating, mortality, swine

Introduction

Successful management of the breeding herd begins with successful breeding practices. Approximately 40% of the red meat consumed annually worldwide (94 million metric tons) is pig meat. Pig numbers (940 million) and consumption have increased consistently with the increasing world population. The world production of swine meat in 2010 reached 101 million tons, with projection of 133 million for 2019 [1]. To meet the increasing demand, artificial insemination could play a major role in the reproduction area.

In the past 50 years, research guided genetic selection and nutrition programs have had a major impact on improving carcass composition and efficiency of production in swine. The use of artificial insemination (AI) in Europe has also had a major impact on pig improvement in the past 35 years and more recently in the USA [2]. A variety of human and environmental factors, in addition to the sow's own genetic potential, affect the efficiency with which sows are bred, and also affect subsequent farrowing success and litter size. AI is used in nearly all modern swine breeding herds, compared to hand or pen mating systems. AI offers economic advantages while improving genetic makeup of offspring when used correctly. AI provides unique genetic opportunities that allow progressive purebred breeders and commercial producers to access the very best or most advanced genetic material available from sires that rank in the top 1% - 2% of their respective breeds for economically important swine production traits. AI enables to maintain sire selection intensity at a maximum level by using the very best sires available within individual breeds. However, in India, use of AI in swine as a breeding technique is negligible.

Hence a pilot study was made at livestock Research Station, Kattupakkam to introduce AI in swine, to assess the reproductive performance and managemental advantages in order to introduce AI of swine in field condition.

Materials and Methods

Artificial insemination versus natural mating: Twenty Large White Yorkshire (LWY) sows at second parity were grouped into two groups (n=10) to study their performance by AI and natural mating. The LWY boars were trained for semen collection using a dummy sow. The semen was collected in a sterile beaker by filtering the jelly material and subjected to microscopical examination to assess the sperm motility and concentration by nigrosin-eosin staining. Fresh semen containing 3 x 10^9 spermatozoa per dose (80 ml) [3] diluted in Beltsville Thawing Solution (IMV Technologies, Gurgoan, India) was loaded in a squeeze bottle under aseptic condition with a rubber tubing to connect the Golden catheter (IMV Technologies, Gurgoan, India).

Table-1. Results of the reproductive performance of sows bred by natural mating and AI

Sr. No	Reproductive traits	AI group (n=10)	Natural mating group (n=10)
1	Number of services done per estrus	2	3
2	Conception rate (%) 100	100	
3	Litter size per farrowing	8.36± 0.28	10.6±0.64**
4	Mortality at birth per farrowing	Nil	0.7+0.26*
5	Birth weight per Piglet	1.53±0.03 kg	1.44±1.16^{NS} kg
6	Weaning weigh on 28 days per piglet	6.86±0.13	6.13±0.10** kg
7	Pre weaning mortality %	4.34	7.5
8	Reproductive complications	Nil	Nil
9	Time consumed during mating persow	11.46±0.47 min	51.2±2.08** min
10	Labour requirement/mating	1	3

* - Varies Significantly; ** - Varies highly significantly; ^{NS}- non-significant

The sows with standing heat were detected and inseminated using the golden catheter in the presence of boar (Figure-1). Two inseminations were done for each sow, one at standing heat followed by second insemination 24 h later. Similarly natural triple mating was allowed for sows on standing heat, 12 h and 24 h later. The sows were maintained at optimal managemental conditions during the gestation period.

Statistical analysis: The reproductive parameters were recorded for both the AI and naturally mated sows to assess their performance and the results were statistically analyzed by Student's 't' test.

Results and Discussion

Artificial insemination was carried out in an organized farm as a pilot study to assess the reproductive performance of sows and their managemental advantage over natural mating. The results were tabulated in Table-1.

Artificial insemination versus natural mating: The results indicated that AI and natural mating practices showed 100% conception rate. The litter size of AI group was 8.36±0.28 and natural mating group was 10.6±0.64 which was highly significant variation. The still birth rate was 0.7±0.26, which was significantly higher in natural mating group. Though the birth weight did not show any significant difference, the weaning weight varied highly significantly. The pre-weaning mortality was 4.34% and 7.5% for AI group and natural mating group, respectively. The time consumed during mating per sow also varied highly significantly which was 11.46±0.47 minutes and 51.2±2.08 minutes for the AI group and natural mating group respectively. The time is inclusive of bringing the sows and boars to contact, reaction time for boars, actual mating time and to lodge them in their sheds for natural mating group. For AI group the time includes semen collection time, semen processing time and insemination time. The labor requirement per mating were 1 and 3 for AI group and natural mating group respectively.

During the past decade, there has been a tremendous increase in the use of AI by commercial swine producers in the United States. In 1990, less than 7% of sows and gilts were bred by AI [4]. The key to widespread application of AI worldwide is the ability to store semen extended in buffers for up to a week near room temperature [5]. A semen extender should be carefully selected according to its proposed use. In this study since the semen was used within 72 h, a short-term extender which is less expensive was used. BTS, probably the most widely used semen extender throughout the world, is characterized by containing a small amount of potassium. This feature preserves the sodium potassium pump and thus avoids intracellular potassium depletion which is related to reduced sperm motility [6,7].

The site of semen deposition determines sperm survivability, litter size and conception rate. The outer (vaginal) end of the cervix is the normal site of semen deposition during natural mating and conventional AI. Within 2.5 h of a conventional AI, approximately 70% of the volume and 25% of the sperm inseminated are lost as they flow back out of the sow's reproductive tract [8]. The back flow is prevented by bending the insemination catheter after insemination and allows it to remain in the vagina for 5 minutes. Though intra-uterine inseminations may reduce the semen volume, however, it needs more breeding technician skills and also may lead to post insemination bleeding [9,10].

The significant increase in the litter size for the natural mating group could be due the availability of sperms to fertilize the ova at the optimum time [11]. There was a significantly higher mortality rate during farrowing, which could be due improper blood supply to the fetus or could be due to space restriction in the uterus. Though there was no significant difference in the birth weight, there was highly significant difference in the weaning weight. The reason could be due to the presence of non-functional teats in the hind quarters or due to reduced milk yield or could be due to better birth weight. The pre-weaning mortality in the AI group was 4.34% which was due to crushing mortality, whereas in the natural mating group, it was due to crushing mortality, colibacillosis, pneumonia and due to hypoglycemia among weak piglets. It is crucial that diligence be given to managing and minimizing the chance of extended semen playing an epidemiological role in the transmission of infectious disease like Brucella, Leptospira, Chlamydophia, Porcine Circo virus 2, classical swine fever, PRRS [12,13,14]. More time was consumed for natural mating compared to AI. AI can be a time saver in piggery farms compared to hand mating Previous study [15] indicated that any time more than four animals were bred in a day, the amount of labor required to supervise matings was significantly less with AI than for natural service. Additionally, as the number of matings per day increased, so did the relative labor advantage of AI over natural service. Another study [16] reported that as numbers of sows bred per day increased the time to inseminate each sow decreased for AI.

Optimal AI schedules are those that result in a high farrowing rate and litter size, while minimizing costs of semen and labor by avoiding unnecessary inseminations. It has been already documented that triple mating will increase the conception rate and litter size by ensuring that adequate live spermatozoa are available at the time of ovulation. Similarly, in AI also, two inseminations were made for the same, as successful AI depends on availability of sufficient spermatozoa to fertilize the ova released. High performance was dependent on ensuring the inseminations occurred at an optimum time in as high a proportion of sows as possible [17]. It could be concluded that AI can be successfully introduced in an organized farm since it has the mangemental advantages like time and labor saving. Further the litter size could be improved by ensuring that inseminations occur at an optimum time resulting in a high farrowing rate and litter size. Further studies should be carried out in assessing the economics involved for AI in an organized farm. As we view newer biotechnologies are now coming, it is clear that a marriage of existing technology (preserved and sexed semen, low-dose insemination, embryo transfer) with genomic, proteomic and disease resistance technology [18,19,20] is required to truly impact improvement of the global swine population.

Conclusion

Successful management of the breeding herd begins with successful breeding practices. In India, use of AI in swine is very rare and hence an attempt was made to introduce swine AI in an organized farm to study the reproductive performance and managemental advantages over natural mating. It was found that AI was found to be time and labor saving. The reduced litter size in AI group could be improved by ensuring that inseminations occur at an optimum time resulting in a high farrowing rate and litter size. The economics involved need to be fine tuned before introducing AI as regular practice since marriage of existing technology (preserved and sexed semen, low-dose insemination, embryo transfer) with genomic, proteomic and disease resistance technology is required to truly impact improvement of the global swine population.

Authors' contributions

BSMR has planned the study and executed along with TPJ and PTG. TPJ has further contributed in statistical analysis and manuscript preparation. TS has made this study possible by providing support in organizing and manuscript correction. All authors read and approved the final manuscript.

Acknowledgements

The authors are very thankful to Tamilnadu Veterinary and Animal Sciences University for providing necessary facilities and fund for conducting this work.

Competing interests

The authors declare that they have no competing interests.

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