Seminar on Boar Semen Application for Pork Quality Improvement

Boar semen quality and insemination workshop

Date: November 8th (Wednesday)
Time: 08:30~11:30AM

Intrauterine Insemination Technology

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Division of Breeding and Genetics, TLRI

Level of estrogen and intensity of typical preliminary signs of estrus relative to ovulation in sows.

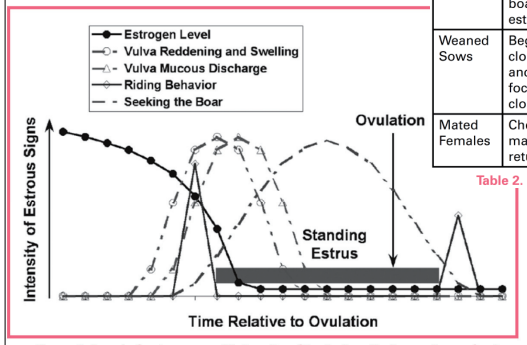


Figure 1. Level of estrogen and intensity of typical preliminary signs of estrus relative to ovulation in sows. Gilts usually display signs of estrus in a similar sequence but vulva reddening and swelling, mucous discharge, and riding behavior may begin to occur earlier and thus last longer than in sows.

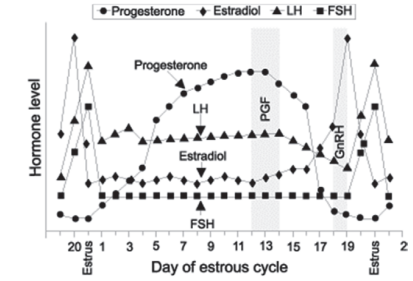
Gilts	Begin boar exposure soon after gilts are introduced to breeding herd. Allow 10 to 15 minutes of direct physical contact with a boar daily. Avoid extremes of constant boar exposure and insufficient boar exposure. Early estrous signs may last longer and standing estrus is often shorter than in sows.
Weaned Sows	Begin boar exposure the day after weaning. Allow a few minutes of close nose-to-nose boar contact daily. Use firm strokes of the flank and underline followed by the back pressure test when the boar is focused on the sow to detect estrus. Recheck any sows that seemed close to standing or that should be in heat.
Mated Females	Check all mated females for estrus daily. Focus on those females mated 18 to 24 days ago. Look for signs that a female may soon return to estrus, such as an abnormal vaginal discharge or abortion.

Table 2. Estrous detection checklist for different types of breeding females.

Goodband et al., 2008

Estrus or Heat Detection

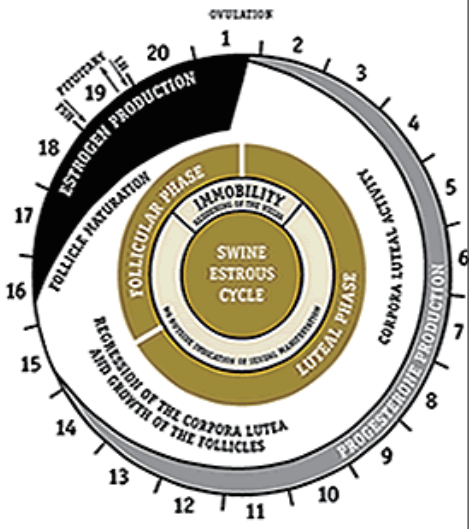
- Signs of Estrus
- Swelling and reddening
- Riding
- Seeking the boar
- Back pressure test



https://www.facebook.com/davsaic.phil
GILT HEAT DETECTION (DAVSAIC INC.)

Estrous Cycle 21 days

- Proestrus 1-3 days
  - Alert to boar but will not accept
- Estrus 3-4 days
  - Physical and behavioral signs
  - Ovulation occurs mid-late estrus
- Diestrus 14 days
- Metestrus 2 days



Ovulation and Fertilization

- Ovulation - last 1/3 estrus q 2hrs
  - Rates Avg 17 sows 13 Gilts (Heritable)
- Fertilization - All or non response
  - Optimal breeding is 12-24 hrs after start estrus
  - Sperm viable for 24 hrs
  - 1st Serv CR 70 – 90% (preg rate?)

The effect of oocyte age at fertilization on fertilization rate and litter size

Est. age of oocyte (hr)	Fertilization rate %	Litter size[a]
0	90.8	12.0
4	92.1	11.7
8	94.6	8.7
12	70.3	6.8
16	48.3	4.8
20	50.9	5.0

[a] Estimated at day 25 post mating

Hunter,1988

The effects of the interval between insemination and ovulation on fertilization rate and embryo viability

	Interval between insemination and ovulation	Sows with >90% Normal Embryos	Fertilization %
Insemination	48-40	17	29
Pre-ovulation	40-32	14	37
	32-24	47	47
	24-16	79	79
	16-8	83	94
	8-0	86	93
Insemination	0-8	54	75
Post-ovulation	8-16	53	62

Soede, et al.1995a

WHY ARTIFICIAL INSEMINATION (AI)

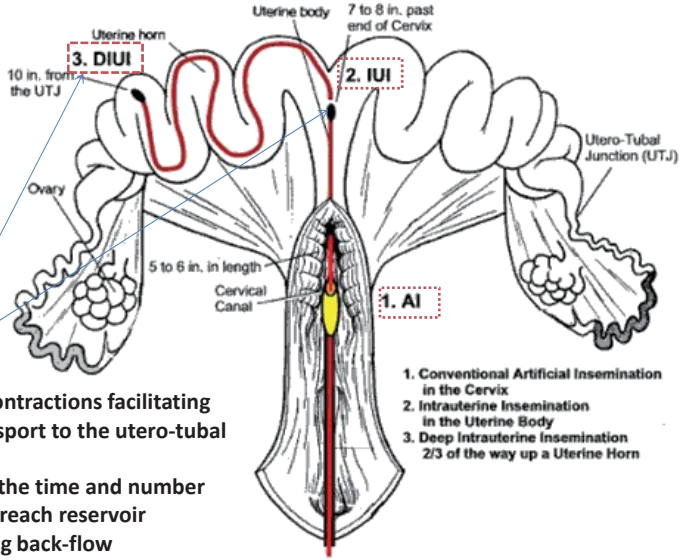
- The primary goal of any AI strategy must ensure a sufficient sperm number in the oviduct at the time of ovulation for optimal fertilization, irrespectively of the sperm numbers delivered and sperm treatment used.
  - Reproductive efficiency
  - Superior genetics
  - Improved recordkeeping
  - Greater boar power
- The current cervical artificial insemination (CAI) procedure, involving deposition of excessive sperm numbers, is uneconomical for pig industry.
- CAI restricts the commercial use of frozen–thawed (FT) sperm and limits the application of sexed sperm, ultimately limiting the economical profitability of valuable sires.

PCAI is a swine insemination technique that can maximize genetic gains and save time and labor.

Two methods of intrauterine AI are currently available

- Deeper innovation for insemination technologies
- The post-cervical insemination (post-CAI)(IUI), developed by Gil et al. (2000, 2004) and Gil (2006).
- The deep intrauterine insemination (DUI), developed by Krueger and Rath (2000) and Martínez et al. (2001, 2002, 2006)
- Designed for the use of very limited numbers of cryopreserved or sex-sorted sperm, which serve fertility limitations.
- Commercially available nowadays (Roca et al. 2006)

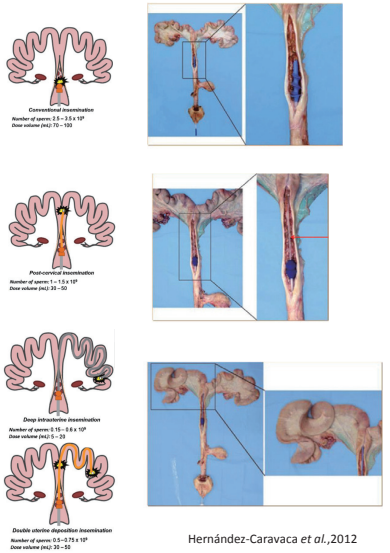
Sperm Deposition From Different Types Of Mating



At this site
1.Uterine contractions facilitating semen transport to the utero-tubal junction
2.Decrease the time and number required to reach reservoir
3.Minimising back-flow

Artificial insemination systems used in pigs and the location of semen deposition

- Cervical artificial insemination (CAI)
- Insemination procedures allowing semen delivery into the uterus body (intra-uterine insemination, IUI)
- To the proximal uterine horn (deep uterine insemination, DUI).



Hernández-Caravaca *et al.*,2012

IUI

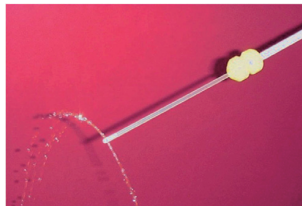


Fig. 1. Tip of the Deepgoldenpig™ catheter emerging from the Goldenpig® device, and illustrating the lateral orifices with fluid emerging.

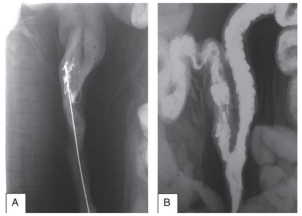


Fig. 3. Radiographs of the position of the Deepgoldenpig™ in situ. (A) Before the insemination is made, and (B) 5 min after insemination had commenced.

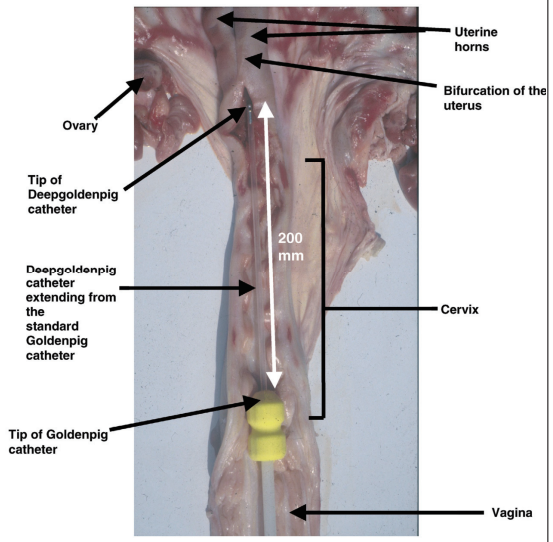


Fig. 2. Reproductive tract of the sow showing the position of the Deepgoldenpig™ at the stage of insemination. Note the tip of the device is in the body of the uterus caudal to the bifurcation.

Watson and Behan,.2002

DIUI

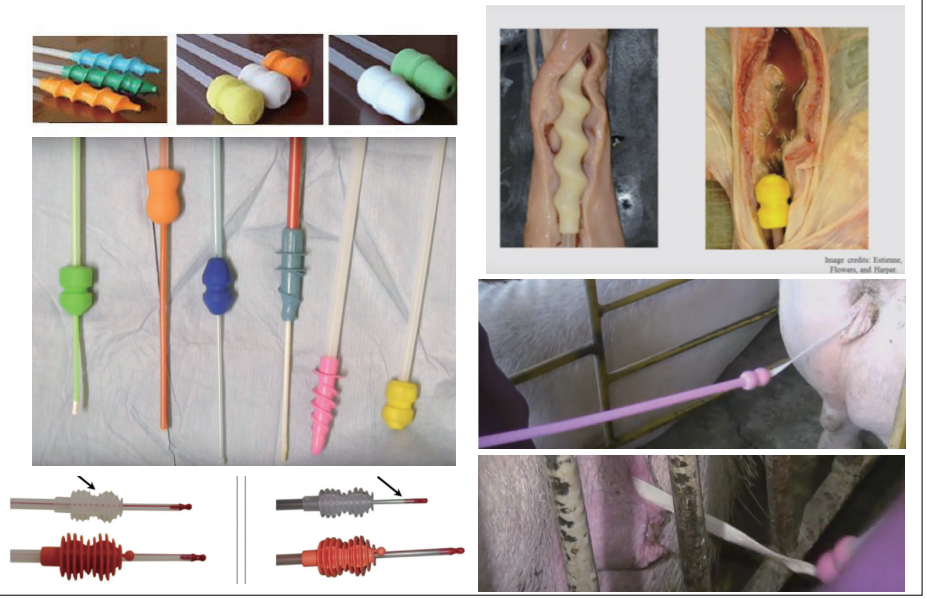
FIGURE 1.
Sperm can be deposited in different procedures: deep intra-uterine insemination (DIUI)

Comparison of different mating way in pig

	Mating with a boar	Traditional AI	Post Cervical AI
Volume fluid, ml	250-400	70-80	15-40
# sperm cells, billions	60-80	2-3	.5-1.5
Location of sperm deposition	cervix	cervix	Uterine body
Length of time	5-10 minutes	3-5 minutes	10-15 seconds

Important fact, the largest majority of the sperm cells that populate the UTJ and the Oviducts is from the first 10 ml inseminated into the cervix and uterus of the sow.

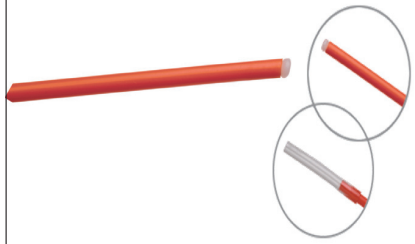
CAI,IUI,DIUI inner and outer catheter



Post cervical artificial Insemination

FOAM Head

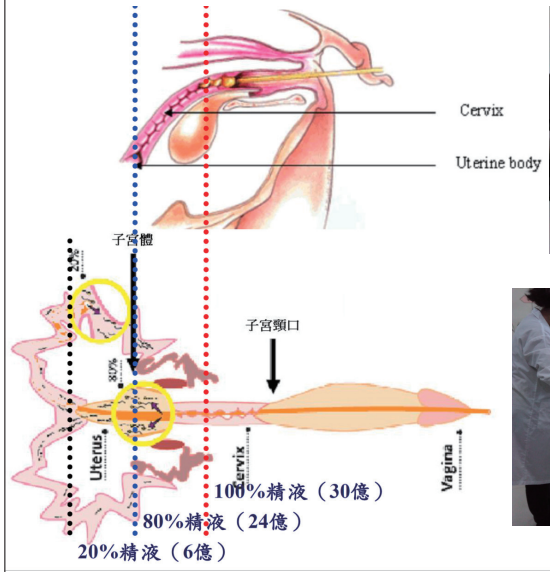
Less agressive
Adaptation
Stimulation
Reduces backflow

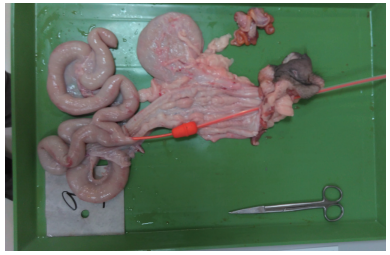


Inner catheter MAGAPLUS S

Soft and flexible, tip specially designed for a safe introduction

Critical requirements for the number of sperm





Minimal number of spermatozoa required for normal fertility after PCAI (IUI)

- Krueger et al (1999) demonstrated that surgical insemination next to the utero-tubal junction with only $1*10^7$ spermatozoa if insemination is done close to ovulation
- Watson and Behan (2002) demonstrated that only 1 billion spermatozoa deposited in the uterine body is enough to obtain a high farrowing rate (86.9% versus 91.1 % standard AI with 3 billion)

Volume and concentration/Post cervical artificial Insemination

Volume and concentration

- Normally, are used:

  1500 million /45 ml of useful spz .

- Also, are used:

  1000 million/30 ml of useful spz.

The doses production technique and the quality of the semen is critical when using PCIA

30-45 ml

Non-return rate at 24 days after IUI (NR), farrowing rate (FR), number of total piglets born/litter (TB) and number of piglets born alive/litter (BA) after IUI with fresh semen (Control) and with frozen–thawed boar semen in spontaneously ovulating sows (group I) and induced ovulating sows (group II).

Table 1

Non-return rate at 24 days after IUI (NR), farrowing rate (FR), number of total piglets born/litter (TB) and number of piglets born alive/litter (BA) after IUI with fresh semen (Control) and with frozen–thawed boar semen in spontaneously ovulating sows (group I) and induced ovulating sows (group II).

Parameters	Group		
	Control	I (spontaneous ovulation)	II (induced ovulation)
No. of sows	20	20	20
Sows non-return to estrus (%)	20/20 (100)[a]	16/20 (80)[a]	17/20 (85)[a]
Sows returned to estrus at irregular interval (%)	0/20 (0)	4/16 (25)	1/17 (5.9)
Sows aborted (%)	0/20 (0)	0 (0)	3/17 (17.6)
Sows farrowing (%)	20/20 (100)[a]	12/20 (60)[b]	13/20 (65)[b]
Total piglets born/litter (mean ± SD)	11.2 ± 2.2[a]	8.0 ± 2.8[b,c]	9.4 ± 3.7[a,c]
Piglets born alive/litter (mean ± SD)	10.7 ± 2.0[a]	7.8 ± 2.8[b,c]	8.7 ± 3.7[a,c]

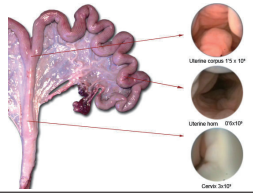
Values are mean ± SD. Values within rows with different letters (a,b,c) are significantly different ($P<0.05$).

Buranaamnuay et al.2010

A-18

Post-insemination(IUI) injury

- **Bleeding(with post-insemination bloody discharges averages 2% and 20%)**
- **Length of advanced (<10% of sows population were found the catheter cannot be advanced the full 200mm)**
- **Difficulties with catheter insertion (1% of sows)**
- **Totally, the passage of catheter through the cervix was not achieved in <3% of sows**



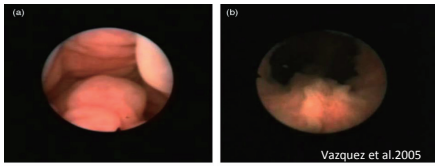


Fig. 1. Endoscopic images of the uterine body one day (a) or five days (b) after onset of estrus.

Deep intrauterine insemination (IUI) presents real Advantages

(1)Reducing the number of spermatozoa inseminated (as few as 0.15–0.6 billion spermatozoa)

(2) Minimizing back-flow

(3)Decreasing the time required for sperm to traverse the cervix and uterus prior to reaching the sperm reservoir.

(4) Reduce the labor associated with insemination

(5) Reduce the time associated with insemination

(6) To facilitate the use of low-dose semen to maximize the use of high indexing boars(use the highest Estimated Breeding Value (EBV) boars can improve performance and carcass)

(7) Allow overcoming some of the weakness of CAI

(8) Frozen-thawed (FT) and sex sorted semen, As sperm is placed nearer the oocyte the limited survival of FT sperm is no longer a problem. (Sumransap et al., 2007)

Several concluding thoughts on PCAI (IUI)(1)

- A boar should not be present in front of the sow during insemination
- Performing PCAI on a sow that is standing in heat will be challenging
- Therefore, wait for 15-20 minutes following heat check to inseminate sows
- PCAI cannot make up for poor management
- Still need to feed sows appropriately during lactation so they come back into estrus
- Need more operator training
- Still need trained employees to perform estrus detection
- Still need to manage semen quality
- If done correctly, PCAI can
  Reduce the labor associated with insemination
  Reduce the time associated with insemination
  Facilitate the use of low-dose semen
- may be used in the field as soon as a suitable insemination device is available
- possible best ways to implement an efficient use of liquid-stored, frozen–thawed and sexed sperm by the pig industry.

Several concluding thoughts on PCAI (IUI)(2)

- In addition, it is important to bear in mind that as the numbers of sperm per AI-dose is reduced, the influence of other variables in the fertility outcome increases.

Variables such as :

- Actual motile or viable sperm rate, boar fertility
- Sow management
- Timing of sperm delivery should be carefully considered.
- Timing of sperm delivery relative to ovulation affecting the overall success of AI

✓ ovulation usually occurs during the final third part of behavioral oestrus (Soede and Kemp 1997), accurate detection of the onset of oestrus as well as monitoring its duration is pre-requisites to properly forecast ovulation under field conditions.

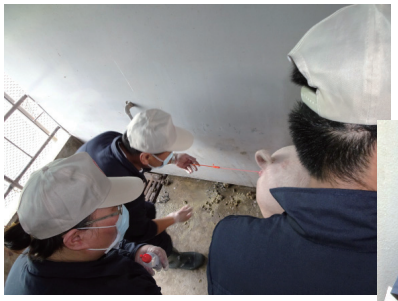
Roca et al. 2011

Conclusions and future remarks

- However, fertility success depends on proper timing of semen deposition relative to ovulation rather than on the site and number of sperm deposed.
- Therefore, convenient and economical protocols to synchronize ovulation are needed for a profitable use of boar spermatozoa, particularly to frozen–thawed and sexed sperm, where single fixed-time AI should be required for efficiency.
- New catheters designed exclusively for gilts.
- How far we can go in reducing sperm numbers per AI-dose
- Reduce the number of sperm required per pregnant sow, thus allowing the best use of valuable boars and, ultimately, the commercial integration of frozen–thawed and sexed sperm
- An efficient use of liquid-stored, frozen–thawed and sexed sperm by the pig industry (daily use of FT semen and of sex-sorted sperm in commercial AI program).

Training course of **pig IUI** at TLRI

Training course of pig IUI at TLRI



DIUI in Pigs at TLRI