Empowering Technology for Pork Industry
Taiwan & Philippines

豬子宮角授精優勢
Potential of porcine intrauterine insemination

Mr. Kuo Ting-Yung
Division of Breeding and Genetics, TLRI
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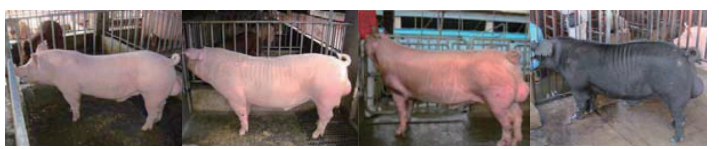

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CURRENT STATUS AND PERSPECTIVES OF IMPROVING THE EFFICIENCY OF ARTIFICIAL INSEMINATION IN PIGS
豬隻人工授精的現況與趨勢 (1)

- *new methods for intrauterine-AI are devised (trans-cervical, deep-intrauterine, double-intrauterine) to deposit low-to-very-low sperm numbers and thus accommodate for further use of selected sperm, either by robustness (colloid-separation) or chromosomal sex, fresh- or frozen-thawed*
- *The development of new extenders and temperatures of conservation, intending avoidance of the interval 16-20℃ towards more convenient cooling temperatures of 5 ℃.(more convenient temp)*
- *To diminishing sperm numbers & volume per AI-dose, so that differences in fertility can be determined between boars (often close to a billion sperm per dose)*
- *Alginate-encapsulated sperm for single AI with liquid semen per estrus, as well as reintegration of autologous seminal plasma (or some selected components) to washed sperm to facilitate sperm survival over time and to be crucial signaling to the female.*
- *Male-to-male variation is still a problem to solve, including our incapacity to properly diagnose fertility levels of boars with an apparent similar semen picture; these males still could yield different fertility after conventional AI.*

2

CURRENT STATUS AND PERSPECTIVES OF IMPROVING THE EFFICIENCY OF ARTIFICIAL INSEMINATION IN PIGS
豬隻人工授精的現況與趨勢 (2)

- *New developments in sperm transcriptomics for semen are encouraging (sperm and seminal plasma/uterine oviduct interaction)*
- *To development of new extenders (antibiotic and more longer)*
- *Number of insemination (single fixed time AI)*
- *New methods for intrauterine-AI (more efficient use of sperm)*
- *New sperm diagnostic method (functional sperm population)*
- *Sperm selection (colloid centrifugation other than sexing)*
- *Boar fertility prediction and /or selecting high fertility boar (male to male variation)*
- *Boar ejaculate freezability (male to male freezability variation)*
- *Sire's seminal plasma profile test*
- *The selection of females for ovulation rate and uterine capacity has led to large - and heterogeneous- litters (often yielding high piglet mortality/weakness).*
- *New strategies for the accurate induction of ovulation (GnRH agonists)*

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WHY ARTIFICIAL INSEMINATION (AI)

- Reproductive efficiency
- Superior genetics
- Improved recordkeeping
- Greater boar power

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Two methods of intrauterine AI are currently available

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

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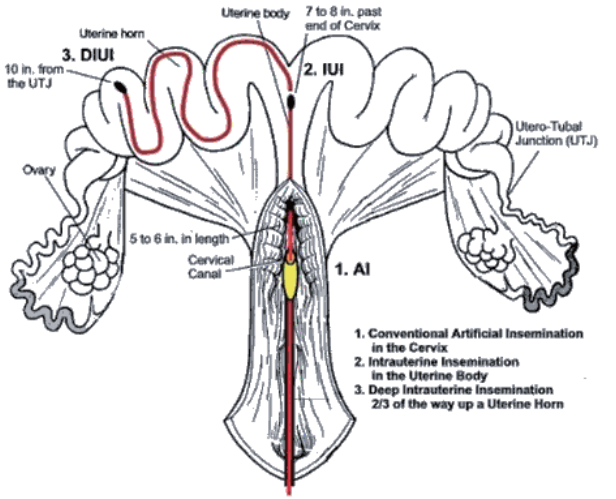
LOW-SPERM AI-DOSE: A TREND TO STAY



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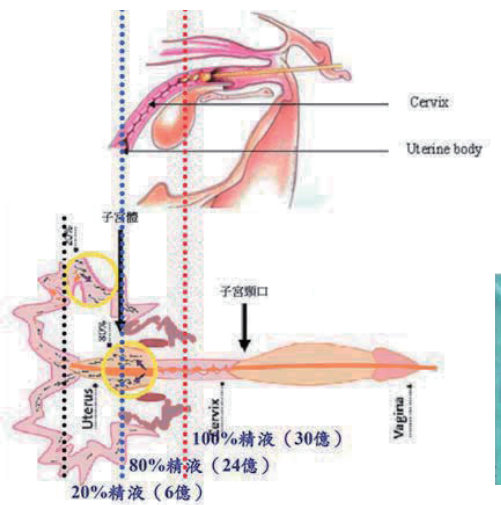
Critical requirements for the number of sperm



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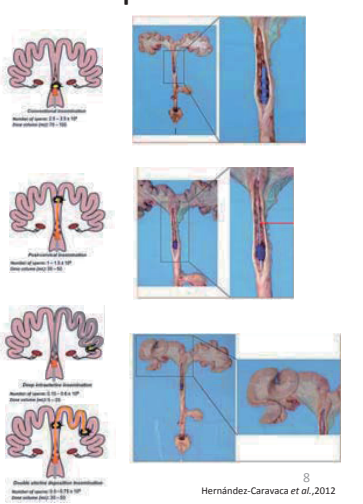
Artificial insemination systems used in pigs and the location of semen deposition

- Cervical artificial insemination (CAI)
  子宮頸注入授精法
- Insemination procedures allowing semen delivery into the uterus body (intra-uterine insemination, IUI)
  子宮體注入授精法
- To the proximal uterine horn (deep uterine insemination, DUI).
  子宮角注入授精法



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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.

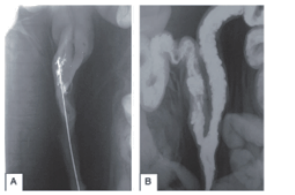

Fig. 3. Radiographs of the position of the Deepgoldenpig™ in situ. (A) Before the insemination is made, and (B) 5 min after insemination had commenced.

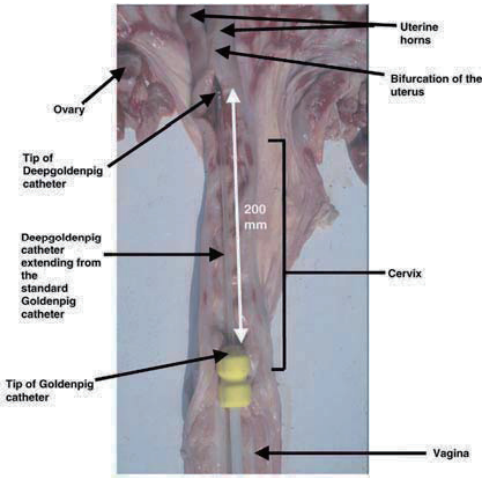

Fig. 2. Reproductive tract of the sow showing the position of the Deepgoldenpig™ at the stage of insemination. Note the tip of the device is in the body of the uterus caudal to the bifurcation.

Watson and Behan,.2002

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DIUI

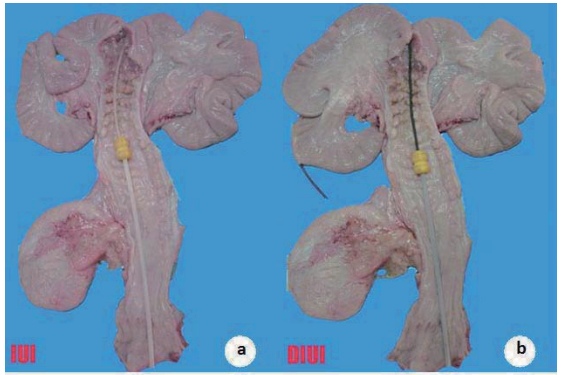

FIGURE 1.
Sperm can be deposited in different procedures: (a) intra-uterine insemination (IUI) and (b) deep intra-uterine insemination (DIUI)

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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)

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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**

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Testing the reliability of the post-CAI(IUI) in FT sperm.

Table 1
Fertility outcomes achieved in some large intrauterine insemination field trials using different numbers of total sperm per insemination dose.

Sperm per AI-dose ($\times 10^6$)	Nr sows	Farrowing (%)	Litter size[a]	References
3000	3240[b]	90.5	12.3	Watson and Behan [7]
2000		92.5	12.3	
1000		86.9	12.1	
3000	859	88.1	12.3	Roberts and Bilkei
1000	924	87.8	10.2	(Cited in [11])
1500	1664	86.8	14.1	Hernandez-Caravaca
1000	1683	84.1	13.9	et al. [12]
750	3099	91.3	16.5	Olesen and Hansen [13]
500	3021	88.9	16.2	

Abbreviation: Nr, number of.
[a] Mean piglets born per litter.
[b] Total sows inseminated.

Roca et al,.2016

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Several concluding thoughts on PCAI (IUI)

- 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
  直接提昇優良公豬精液之使用效率
  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.

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Deep intrauterine insemination (IUI) presents real advantages

(1)reducing the number of spermatozoa inseminated
(as few as 0.15–0.6 billion spermatozoa)
(2) minimising back-flow
(3)decreasing the time required for sperm to traverse the cervix and uterus prior to reaching the sperm reservoir.
(4)Frozen-thawed (FT) semen, As sperm is placed nearer the oocyte the limited survival of FT sperm is no longer a problem. (Sumransap et al., 2007)
(5)Reduce the labor associated with insemination
(6)Reduce the time associated with insemination
(7)To facilitate the use of low-dose semen to maximize the use of high indexing boars

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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.

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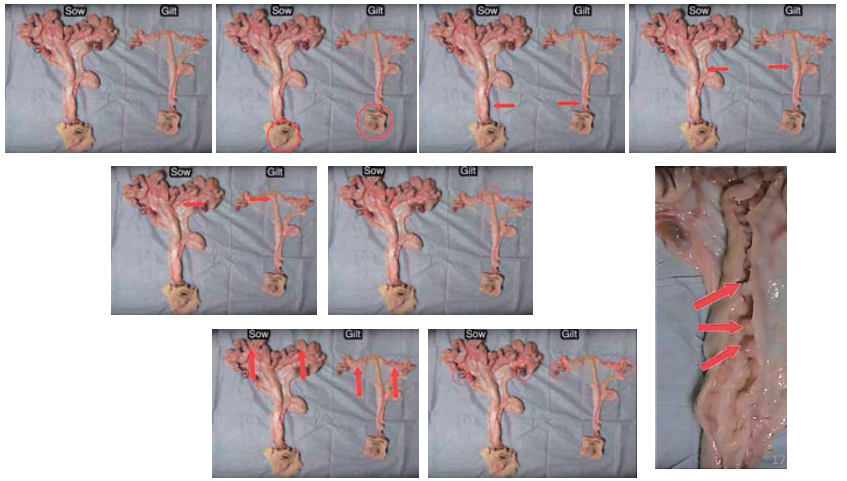
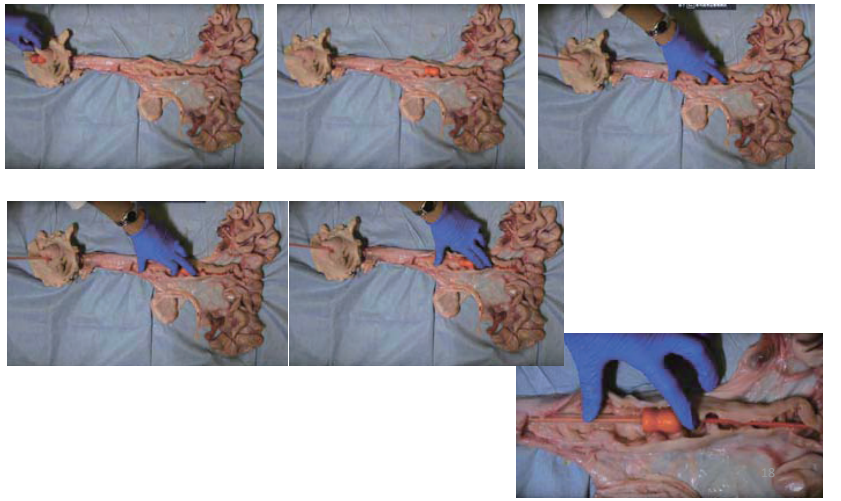
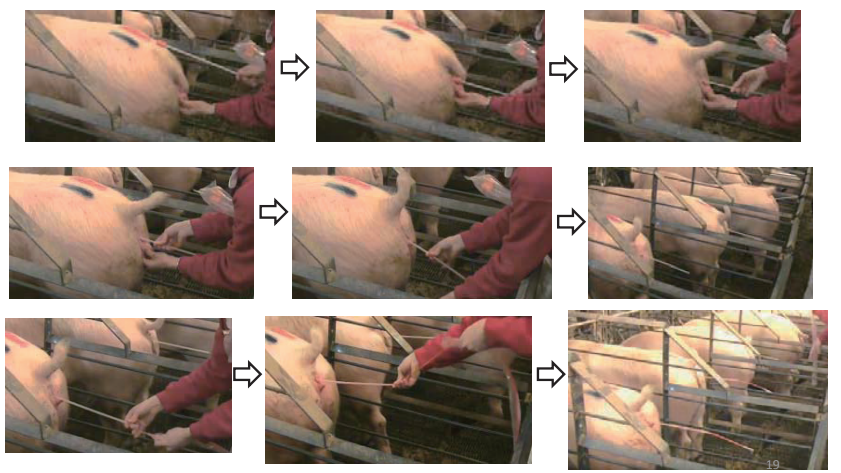
Reproductive tract comparison between sow and gilt
經產母豬與發育女豬之生殖道比較



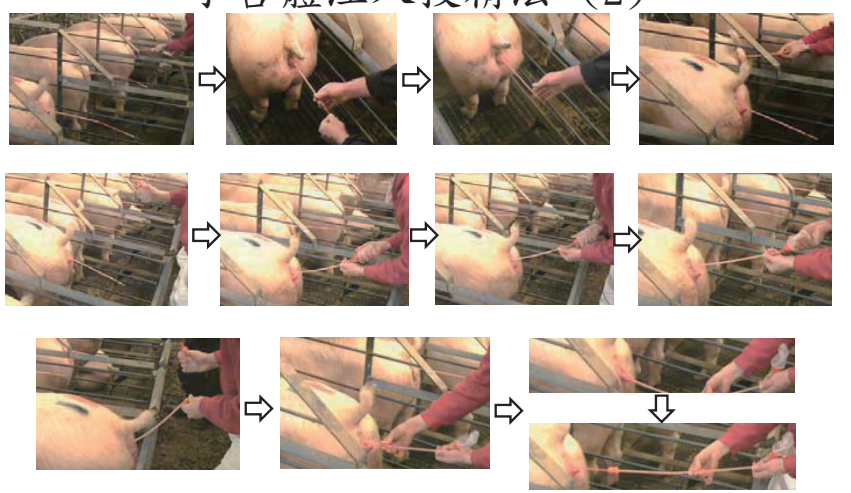
How does PCAI work



Process of doing PCAI (1)
子宮體注入授精法 (1)



Process of doing PCAI (2)
子宮體注入授精法 (2)



母豬耳號	配種日期	公豬耳號	精子數	預產期	分娩日	產仔數	公(頭/活)	母(頭/活)	備註
Y1263-7	105/7/25	Y1220-12	5000萬/20mL	105/11/17	105/11/16	14	10	4	14
Y1259-1	105/8/13	Y1214-12		105/12/06	105/12/07	12	9/7	3/3	10胎號025
Y1264-5	105/8/19	Y1214-12		105/12/11	105/12/11	8	6	2	8 胎號026
Y1255-03	105/10/06	Y1214-12							無法懷孕
Y1262-02	105/11/07	Y1169-10		106/02/	106/02/				懷孕中

Y1263-7(分娩日1051116)
生10公4母

Y1259-01於12月5日生9公3母

Y1264-5於12月11日生八頭6公2母

2017/4/12~14 豬精液選用與人工授精技術進階選修班

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Thank you !

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