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猪人工授精新技术

（美国南达科达州立大学供稿）

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美国大豆协会-国际项目

上海代表处



Training Boars for Semen Collection

训练公猪进行采精

- Select a person who is patient and enjoys working with animals.选择一个有耐心并乐于与动物相处的人
- Begin training during the isolation process by building a trust between you and the boar. Spend a few minutes each day scratching, rubbing and talking with the boar.训练开始于隔离过程中，这时要在操作者和公猪之间建立信任，每天花几分钟对公猪抓痒、擦拭和“对话”
- Boars vary in their rate of sexual development. Some 7 mo old boars are ready to be trained and others require 4 - 6 wks longer.不同公猪的性成熟速度各异，有些7月龄的公猪就可投入训练，而另一些可能要晚4～6周才行。

Training Boars (con't)公猪训练(续)

- Provide a clean, dry, well lighted area free of distractions. A breeding mat helps provide footing. A boar that slips during mounting may be shy about attempting it again.
- 训练场地应该清洁、干燥、光照良好且无干扰。地上铺上一个防滑垫可有助于公猪站稳，公猪在爬跨时滑倒会羞于再次爬跨。
- Keep the area about 8 x 10 ft, so that the boar is focused.
- 训练区域大小应在8×10英尺左右，以便公猪能够集中精力。
- If possible, collect a previously trained boar first. The odor and sound may stimulate the "rookie" if he is located next to the collection area.
- 如有可能,先对先前接受了训练的公猪采精。令新公猪站在近旁,采精时的气味和声响会对新公猪产生刺激

Training Boars (con't)公猪训练(续)

- Adjust the dummyso that it is equal to or slightly lower than the boar being trained.调整假母猪的高度，使其等于或略高于训练公猪的高度。
- Plan for short training sessions (15 -20 min). Some boars may mount the dummy immediately but others may want to explore the pen and dummy for several session.每次训练时间应该短些(15 ~ 20分钟)。有些公猪会立即爬跨假母猪，而有些公猪在开始几次训练中只是探究猪圈和假母猪。

Training Boars (con't)公猪训练(续)

- Some boars require coaxing. Crouchdown near the dummy, allow the boar to smell your hand and clothes and talk in a reassuring tone. Try pouring semen from a previous collection on the dummy.对有些公猪需要哄骗。要在假母猪旁边蹲下，让公猪嗅闻你的手和衣服，采用使公猪安定的声调召唤公猪。
- Keep the boar focused on the dummy. If needed, use winged gates to keep him in front of the dummy.要使公猪集中关注假母猪。需要时可用winged gate使公猪呆在假母猪的前面。

New Technologies新技术

- Boar semen extenders公猪精液稀释剂
- Intra-uterine Insemination子宫内输精
- Sexing of boar semen公猪精液性别化
- Cloning and embryo transfer克隆和胚胎移植

Reasons for developing new long-term boar semen extenders研制长效公猪精液稀释剂的原因

- More favorable work hours in boar stud
- 增加人工授精站的有效工时
- Reduction or elimination of weekend collections
  减少或避免周末采精
- Reduced transportation cost of semen
- 降低精液运输成本
- Testing of semen for PRRS before shipping/using semen可在精液运输/应用之前测试其是否受到猪繁殖和呼吸综合征病毒污染
- Longer storage life of延长精液储存时间
- Fewer discards at the farm减少猪场中精液浪费

New Long-Term Extenders
新的长效稀释剂

- Non-published formula未发表配方
  - Androhep® EnduraGuard™
  - Androhep® EnduraGuard™
    - Shelf-life is 9 days有效期9天
    - Antibiotics抗生素
  - SafeCell Plus™ SafeCell Plus™
    - Shelf-life is 9 days有效期9天
    - Liquid concentrated extender液态浓缩稀释剂
    - Specific blend of antibiotics与抗生素混合
  - Mulberry III Mulberry III
    - Shelf-life is 7 to 14 days有效期7～14天
    - Antibiotic抗生素

Intra-uterine Insemination

子宫内输精

- Intra-uterine “body” insemination (IUBI)子宫内输精(子宫体内输精)
- Deep intra-uterine “horn” insemination (DIUHI)深部子宫内输精(子宫角内输精)

Suggested beneficial aspects of intra-uterine body AI:

子宫体内输精的好处

- Less back-flow减少精液回流
- Fewer sperm cells per dose可减少每次输精的精子数
- Smaller volume required可减少每次输精的精液量
- Less time needed to inseminate可减少每次输精花费的时间
- Less boars will be needed to produce sperm cells公猪的头数
- Genetic cost will be lower?可降低种猪成本？

Percentage of sows inseminated that have backflow with traditional AI

传统输精法的精液回流情况

Time of backflow 精液回流	No. sows evaluated 测试母猪数	No. sows with backflow 有回流母猪数	% of sows with backflow 有回流母猪%
During AI 输精中	120	76	63.3
0 to .5 hr after AI 输精后0～0.5小时	112	110	98.2
.5 to 2.5 hr after AI 输精后0.5～2.5 小时	80	78	97.5

Stevernik et al., Animal Reproduction Science 54:109-119, 1998.

Proportion of total volume (80 mL) that was lost during and after traditional Ai

传统输精法总输精量80毫升中输精中和输精后的损失比例

Time of backflow 回流时间	No. sows evaluated 测试母猪数	Total volume lost, %损失量%	
		Average平均	Range范围
During AI 输精中	76	7%	1 to 56%
0 to .5 hr after AI 输精后0～0.5小时	110	31%	3 to 76%
.5 to 2.5 hr after AI 输精后0.5～2.5 小时	78	36%	1 to 94%

Stevernik et al., Animal Reproduction Science 54:109-119, 1998.

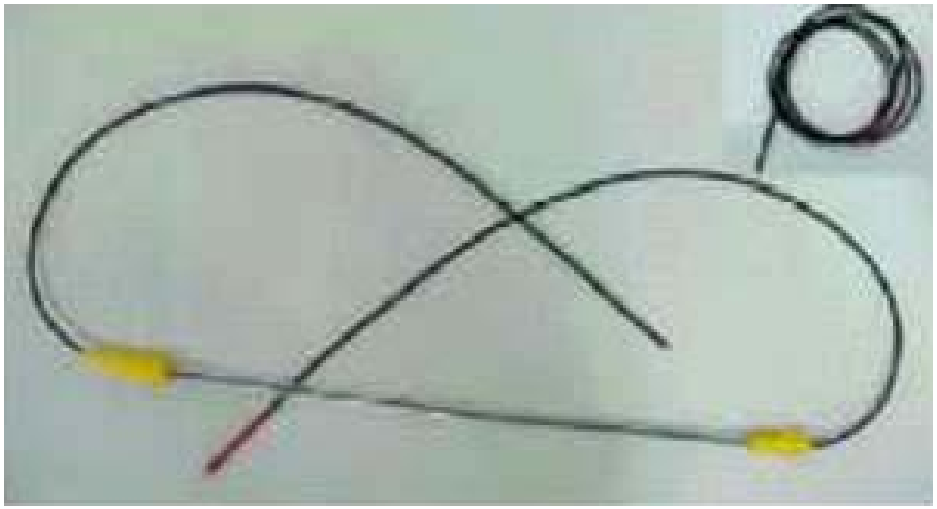
Deep Intra-uterine Horn Insemination

深部子宫角内输精

- Surgical procedure外科手术法
  - Not practical for commercial use
  - 不适合用于商业目的
- Fiber optic endoscope光纤内镜
  - Not practical for commercial use
  - 不适合用于商业目的
- Flexible catheter柔软导管
  - Used on non-sedated estrous sows
  - 用于非呆立发情的母猪
  - Practical for commercial use
  - 适合用于商业目的

Deep Intra-uterine “Horn” Artificial Insemination

深部子宫角内输精



FirFlex® Catheter

(Patented by University of Murcia)

FirFlex®输精管(专利权Murcia大学)

Marketed in Europe by MAGAPOR
(Spain, Portugal, Hungary)

由MAGAPOR公司在欧洲销售
(西班牙，葡萄牙，匈牙利)

DNA differences between X- & Y-chromosome-bearingspermatozoa

X精子和Y精子之间的差异

- Vole田鼠– 12.5%
- Chinchilla南美栗鼠 – 7.5%
- Sheep绵羊– 4.2%
- Dog狗– 3.9%
- Cattle牛– 3.8%
- Elk]麋鹿 – 3.8%
- Horse马– 3.7%

- Pigs猪– 3.6%
- Elephant象– 3.4%
- Camel骆驼– 3.3%
- Rabbit兔– 3.0%
- Human人– 2.8%
- Possum负鼠– 2.3%
- Turkey火鸡– 0.0%

L. A. Johnson. Animal Reproduction Science 60-61:93-107, 2000.
L. A. Johnson. Reproduction, Fertility, and Development 7:893-903, 1995.

Current problems with sexing boar semen:公猪精液性别化中的问题

- Sorting process is too slow性别鉴定过程太慢
  - 6 million per hour for X每小时6百万个X精子
  - 6 million per hour for Y每小时6百万个Y精子
  - 11 million per hour when sorting for only X
    仅仅选择X精子可达每小时1100万
- Decreased reproductive performance
- 降低繁殖性能

Stimulating/Priming Uterus
刺激/敏化子宫

- Adding oxytocin to each dose of semen在每份精液中加入催产素
- Adding prostaglandin to each dose of semen 在每份精液中加入前列腺素
- “Inserting” MR-A Predil prior to insemination 输精前加入人工合成的精浆制品MR-A Predil
- Mating gilts with sterile boar用不育的公猪与小母猪交配
- Inseminating gilts with dead semen用死精给小母猪输精

Farrowing rate and number of piglets born alive per litter when oxytocin was injected prior to inseminating with "old" sperm cells.用老精子输精前注射催产素时母猪的分娩率和窝产仔数 (BTS semen extenderBTS精液稀释剂)

Treatment处理	Farrowing rate, % 分娩率(%)	Litter size 窝产仔数
Sperm cells >72 hours of age 大于72时龄的精子	68.2 [a] (n = 55)	9.4 [a]
Sperm cells >72 hours of age + oxytocin 大于72时龄的精子+催产素	85.2 [b] (n = 59)	10.1 [b]
Difference差异	17.0	0.7

[ab] (P < .05)

W. L. Flowers, NSCU

Adding Lutalyse to a dose of semen increased farrowing rate and litter size

在精液中加入律胎素可提高分娩率和窝产仔数

Item项目	Lutalyse 律胎素	Control 对照	Difference 差异
Number of sow & gilts母猪头数	1575	1552	23
Farrowing rate, % 分娩率(%)	83.80	80.61	3.19
Litter size窝产仔数	10.15	10.08	.07
FI	851	813	38

.5 to 1.0 mL Lutalyse (PGF2a) per dose of semen每份精液加入0.5～1.0毫升律胎素(PGF2a，前列腺素)

MR-A Predil increased farrowing rate and litter size of gilts [Summary of three studies]

合成精浆MR-A Predil可提高分小母猪的娩率和窝产仔数(三个研究综述)

Item项目	Predil 合成精浆	Control 对照	Difference 差异
Number of gilts 小母猪数	296	324	28
Farrowing rate, % 分娩率%	86.80	82.07	+4.73
Litter size窝产仔数	10.28	10.04	+.24

Mating gilts at puberty with a vasectomizedboar increased farrowing rate

用输精管切除的公猪与初情期小母猪交配可提高分娩率

Study 研究	Gilts mated to sterile boar at puberty用不育公猪与初情期小母猪交配	Gilts were not mated不与小母猪交配	Difference 差异
1 (n = 265)	87.0	81.0	6.0
2 (n = 192)	88.0	85.0	3.0

Note: Gilts were mated to fertile boar at second estrus.用第二情期小母猪与有生育力公猪交配

Mating gilts at puberty with a vasectomized boar increased litter size

用输精管切除的公猪与初情期小母猪交配可提高窝产仔数

Study研究	Gilts mated to sterile boar at puberty用不育公猪与初情期小母猪交配	Gilts were not mated不与小母猪交配	Difference差异
1 (n = 265)	9.9	9.5	0.4
2 (n = 192)	10.4	9.6	0.8
3 (n = 98)	10.9	9.3	1.6
4 (n = 34)	10.9	9.5	1.4

Note: Gilts were mated to fertile boar at second estrus.

用第二情期小母猪与有生育力公猪交配

Pregnancy Diagnosis妊娠诊断

- Blood tests (23 to 30 days)验血(23～30天)
  - Progesterone (RIA procedure)孕酮(放射免疫法)
  - Estrone sulphate硫酸雌酮
  - Estrone glucuronide葡(萄)糖苷酸雌酮
  - Estradiol glucuronide]葡(萄)糖苷酸雌二醇
- Fecal tests (20 to 21 days)粪检(20～21天)
  - Progesterone (RIA procedure)孕酮(放射免疫法)
  - Estrone (ELISA procedure)雌酮(ELISA)法
- Urine tests (23 to 30 days)尿检(23～30天)
  - Conjugated estrone (RIA) 共轭雌酮(放射免疫法)
  - Estrone sulphate (immunoenzymatic)硫酸雌酮(免疫酶法)
- Ultra-sound techniques超声波技术

Synchronization of Estrus同期发情

- **PGF_{2a}** – can be effective in shortening the luteal phase after d 12 of the estrous cycle. Usually 2 i.m. injections of 10 mg/ea 12 h apart.前列腺素PGF_{2a}可有效缩短发情周期12天后的黄体期。通常注射二次，每次10毫克，肌肉注射；二次注射间隔12小时
- Matrix – a progestagen? (altrenogest) fed to cycling sows and gilts at 15 mg/d for 14 d. Upon removal of matrix, estrus occurs 6 days later. Costs ~ $1.50/h/d.孕激素(烯丙孕素，为人工合成的孕激素)饲喂给发情的母猪和小母猪，每天喂15毫克，喂14天。停喂后6天即发情。每天每头1.50美元
- Weaning – Weaned sows exhibit estrus by d 3 -7 after weaning. This may be combined with administration of PG 600 (~$5.00/dose).断奶——断奶母猪会在断奶后3～7天发情，可在断奶的同时应用PG600(每剂5.00