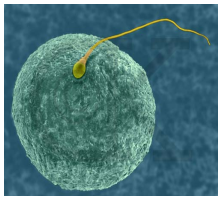
## Insemination Related Factors Affecting Fertilization In Estrous-Synchronized Cattle



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## Factors important to fertilization

- Semen quality and number of sperm
- Accessory sperm
- Time of AI
- Semen handling and deposition
- Fertility associated antigen?

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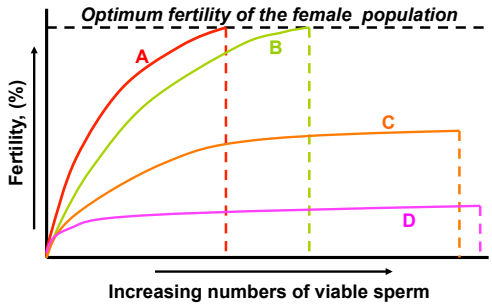
## Relationship of semen quality and quantity to fertility




(Adapted from Salisbury and VanDemark, 1961; Saacke et al., 1994)

## Semen quality

**"Compensable" seminal traits:**

- Viability or morphology traits impairing sperm transport and ovum penetration; fertilization does not occur
  - Severely misshapen sperm in an otherwise normal semen sample

***Reduced fertility may be overcome or minimized by increasing sperm numbers***

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(Saacke et al., 1994)

## Semen quality

**"Uncompensable" seminal traits:**

- Incompetence of the fertilizing sperm; completion of fertilization and maintenance of the embryo does not occur
  - Damaged DNA in otherwise normally shaped head of fertilizing sperm?

***Reduced fertility regardless of sperm dosage***

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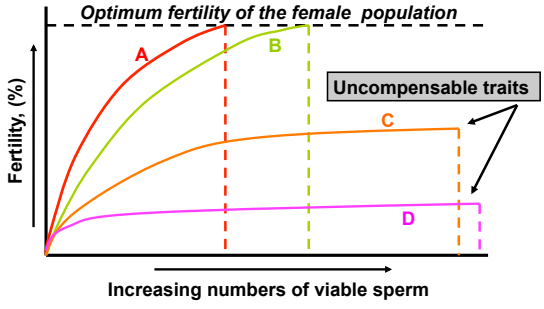
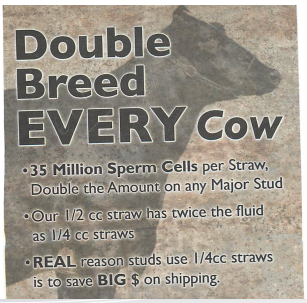
(Saacke et al., 1994)

## Relationship of semen quality and quantity to fertility




(Adapted from Salisbury and VanDemark, 1961; Saacke et al., 1994)

## What does this mean?

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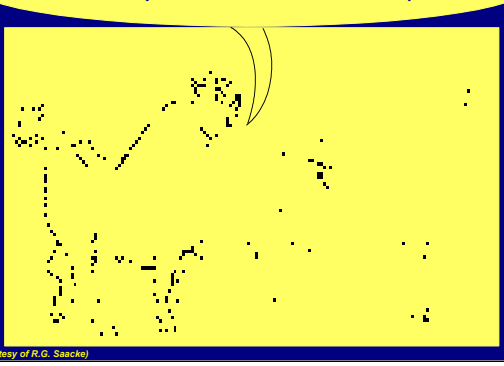
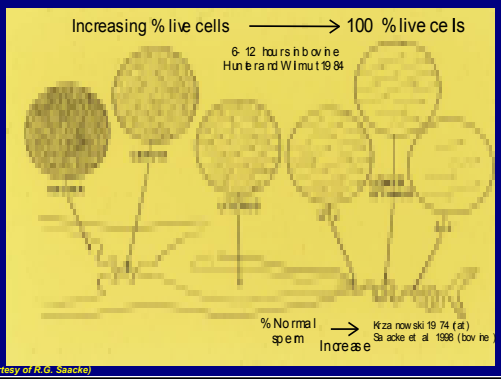
## What did you do with all those sperm?



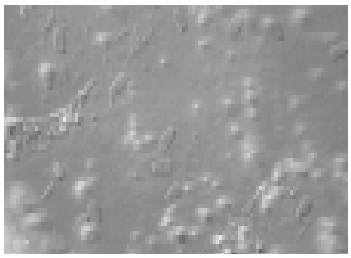
(Courtesy of R.G. Saacke)

## Sustained sperm transport (Overstreet et al. 1978)




(Courtesy of R.G. Saacke)

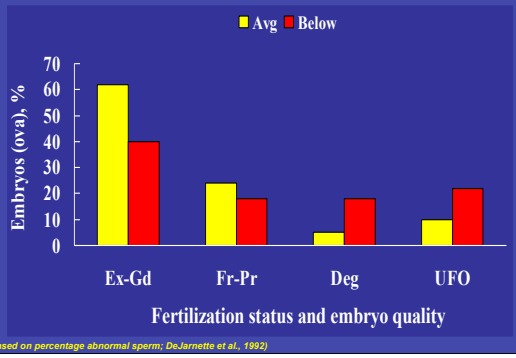
## What is the significance of accessory sperm?



**Increased accessory sperm number is associated with increased fertilization rate and embryo quality.**

(DeJarnette et al., 1992; Nadir et al., 1993; Photo courtesy of R.G. Saacke)

## Effect of average vs. below average semen† on fertilization status and embryo quality




(†Based on percentage abnormal sperm; DeJarnette et al., 1992)

## Effect of time of AI in estrous synchronized beef heifers

- Retrospective study
- HeatWatch
- Heifers assigned to 4-h time block based on time from onset of estrus to AI.
- Fertility:
  - AI 0 - 4 h after onset of estrus (48.1%)
  - AI 4 - 24 h after onset of estrus (63.7%)
  - AI >24 h after the onset of estrus (55.9%)

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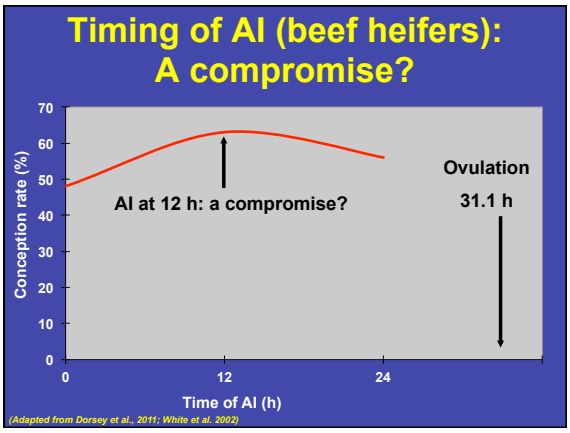
(Dorsey et al., 2011)




**How does time of AI affect fertilization rate, embryo quality and accessory sperm?**

| Time of AI | N | Accessory sperm Mean ± SD | Accessory sperm Median | Fertilization rate, % |
|---|---|---|---|---|
| 0 h | 39 | 9 ± 23 | 1 | 66 |
| 12 h | 39 | 21 ± 46 | 2 | 74 |
| 24 h | 39 | 33 ± 53 | 4 | 82 |

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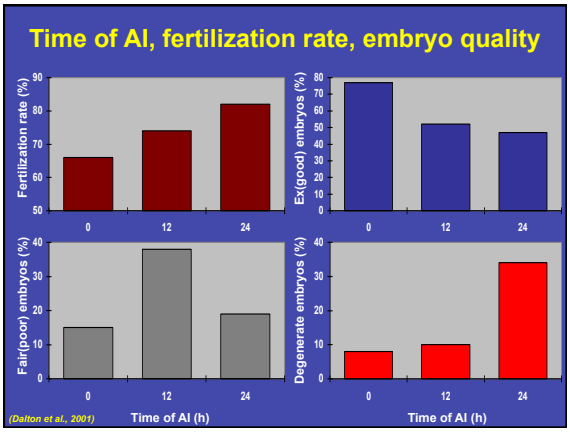
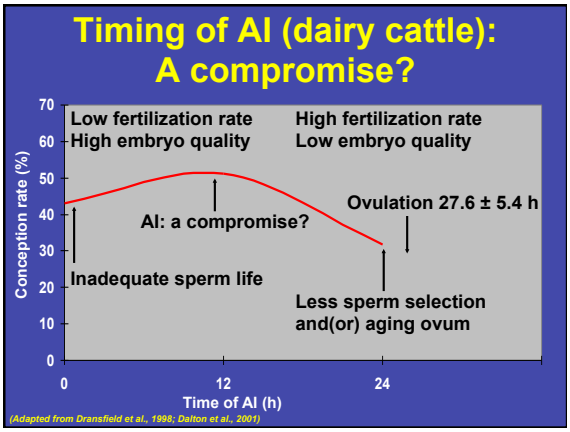
(Dalton et al., 2001)




**How many straws should be thawed at one time?**

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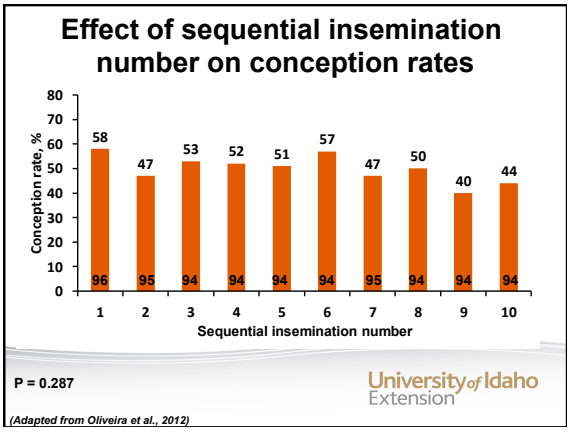


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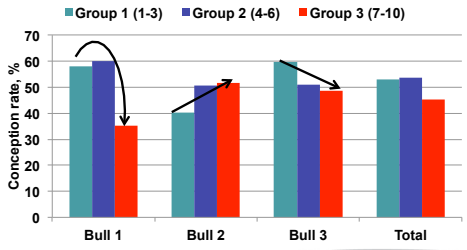
## Sire x straw group interaction




Interaction: Sire x Straw Group: P = 0.002
Effect of straw group: P = 0.046

*(Adapted from Oliveira et al., 2012)*

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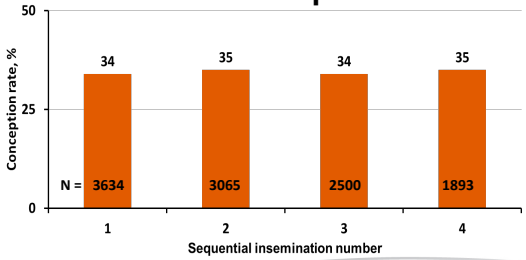
## Effect of sequential insemination number on conception rates




*(Adapted from DeJarnette et al., 2002)*

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## How many straws should be thawed at one time?

- No more than can be used in 10 - 15 min.
- "Know your comfort zone."
- Do not allow straws to touch when thawing.
- Use multiple thaw baths.
- Time, temperature, hygiene, skill.

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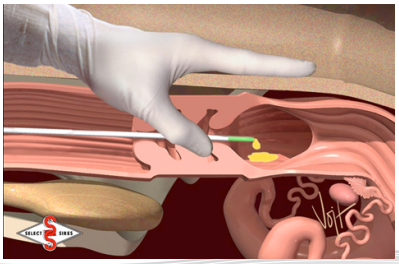
## Inseminator skill: Deposition of semen



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## Importance of re-training

| | Initial | After re-training |
|---|---|---|
| Location | Placement, % | Placement, % |
| Left uterine horn | 14 | 0 |
| Right uterine horn | 48 | 18 |
| Uterine body | 24 | 67 |
| Cervix | 9 | 12 |
| Vagina | 5 | 2 |

*(King and Macpherson, 1965)*

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## Does fertility-associated antigen on sperm collected from Nelore *(Bos indicus)* bulls affect fertility at first-service timed AI?

*(Dalton et al., 2012)*

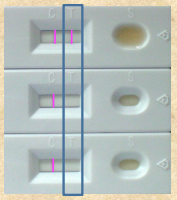
## Fertility associated antigen

- During ejaculation, the seminal vesicles, prostate, and Cowper's glands secrete heparin-binding proteins (HBP) which coat the sperm.
- Bulls with sperm that exhibited a 31-kDa molecular weight HBP, called fertility-associated antigen (FAA), were 7 to 9 percentage points more fertile following AI than bulls producing sperm lacking FAA.

*(Miller et al., 1990; Sprott et al., 2006)*

## Materials and Methods

- Presence of FAA in the sample results in a visible colored band at the test position.




*(ReproTest, ReproTec Inc., Tucson, AZ, USA)*

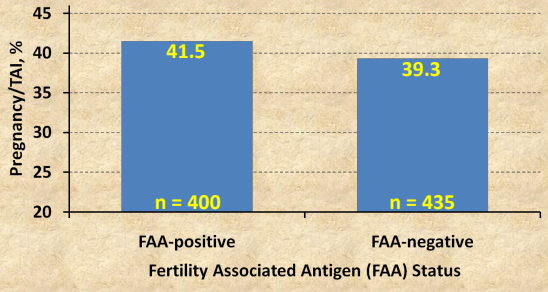
## Materials and Methods

Six Nelore bulls:

- FAA status:
  - negative: n = 3
  - positive: n = 3
- Semen characteristics equal to or greater than:
  - 70% morphologically normal sperm
  - 60% estimated progressive motility before cryopreservation
- Extended semen was packaged and cryopreserved in 0.25-mL straws ($30\times10^6$ sperm).

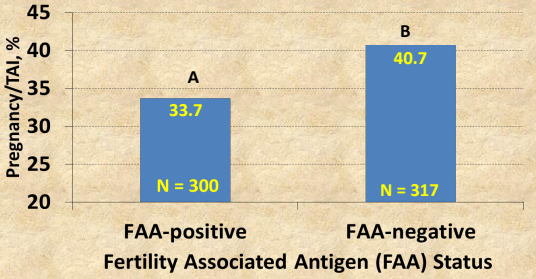
*(Dalton et al., 2012)*

## Fertility (Pregnancy/TAI):Cows




*(Dalton et al., 2012)*

## Fertility (Pregnancy/TAI):Heifers




*(Dalton et al., 2012)* *(A,B differ P = 0.04)*

## Conclusions

- There was no effect of FAA status on fertility at first-service TAI in lactating cows.
- Fertility, as measured by P/TAI, was different between FAA-positive and FAA-negative bulls (33.7% vs. 40.7%, respectively).

*(Dalton et al., 2012)*

## Take home messages

- Compensable seminal traits: Ability of inseminated sperm to initiate fertilization?
  - Reduced fertility may be overcome or minimized by increasing sperm numbers.
- Uncompensable seminal traits: Competence of the fertilizing sperm to complete fertilization and sustain early embryonic development?
  - Reduced fertility regardless of sperm dosage.

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## Take home messages

To reduce the risk of uncompensable seminal traits:

- Use semen from AI Studs where morphology is a routine part of the evaluation.
- Use multiple, proven high fertility bulls.
- Screen all natural service bulls with a complete breeding soundness evaluation, including sperm morphology.

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## Take home messages

- Time of AI: Close enough to ovulation to maximize sperm access to the ovum, but not too late to have an aging ovum awaiting sperm arrival.
- Proper semen handling is critical to the success of AI.
- Presence of FAA on spermatozoal membranes does not guarantee higher fertility.

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## Acknowledgements


- M. DeJarnette
- R. Nebel
- J. L. M. Vasconcelos
- L. Deragon
- R. F. G. Peres
- C. N. Lopes
- Select Sires
- NAAB
- VA Ag Council
- Alta Genetics Brazil
- Animal Health Express


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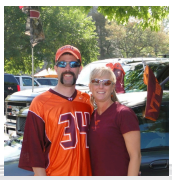
## Acknowledgements


- Sher Nadir, Genex, Shawano, WI
- R.G. Saacke and Judy Bame, Virginia Tech
- M. Noftsinger, Emergency Veterinary Services

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## Thank you.