

Predicting and Promoting Fertility in Bulls



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Introduction

- In 2009, more than 94% of cows and 79% of heifers were exposed to bulls only.
- Approximately 4% of cows and 12% of heifers received (AI) followed by exposure to bulls.

Whether for natural service or AI, cattle producers are interested in identifying the most fertile bulls.

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Sperm attributes necessary for fertilization

- “Acceptable” morphology
- Metabolism for production of energy
- Progressive motility
- Capacity for hyperactive motility
- Stabilization of plasma and acrosomal membrane lipids
- Acrosomal enzymes
- Chromatin integrity

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Double Breed EVERY Cow

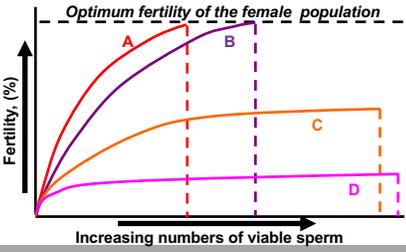
- 35 Million Sperm Cells per Straw, Double the Amount on any Major Stud
- Our 1/2 cc straw has twice the fluid as 1/4 cc straws
- REAL reason studs use 1/4cc straws is to save BIG \$ on shipping.

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How many sperm are needed to maximize the chance at a pregnancy?

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Relationship of Semen Quality and Quantity to Fertility



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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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(Sacke et al., 1994)

Semen Quality

“Uncompensable” seminal traits:

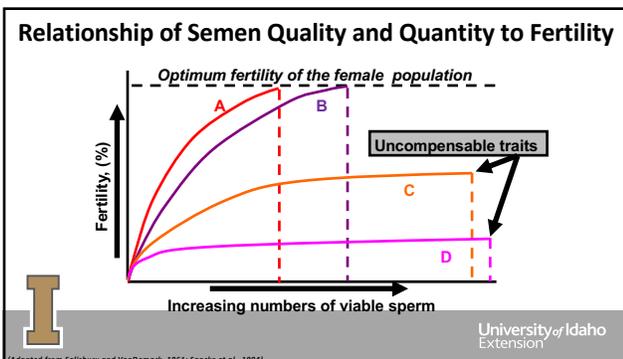
- Incompetence of the fertilizing sperm; completion of fertilization and maintenance of the embryo does not occur
- Damaged DNA in otherwise normally shaped head of fertilizing sperm?

Reduced fertility regardless of sperm dosage.



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(Sacke et al., 1994)



SPERM DOSE TITRATION STUDY: A COLLABORATION



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(Menegatti Zocca et al., 2017, 2018)

OBJECTIVE

To determine the effect of sperm dose (10M, 20M, 20M and 40M) on pregnancy per fixed time AI in Brazilian beef cattle.



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(Menegatti Zocca et al., 2017, 2018)

MATERIALS AND METHODS

- 5 Angus bulls (Select Sires, Inc.)
- Proprietary milk-based extender (Select Sires, Inc.)

- 4 doses
 - 10 M/straw
 - 20 M/straw
 - 20 M/straw
 - 40 M/straw
- 0.5 ml straws in 4 colors:
 - Yellow
 - Red
 - Purple
 - Brown



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(Menegatti Zocca et al., 2017, 2018)

RESULTS

- No effect of sperm dose on P/TAI was revealed ($P = 0.31$).

Sperm dose; 10^6	n	P/TAI; %
10	1,231	43.8
20-a	1,204	45.3
20-b	1,182	43.8
40	1,249	47.1

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RESULTS

- A fertility difference between bulls was detected ($P < 0.05$).

Bull	n	P/TAI, %
A	1,050	48.1 ^a
B	1,058	47.7 ^a
C	1,206	40.7 ^c
D	747	45.5 ^{ab}
E	805	43.1 ^{bc}

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RESULTS

- Range in fertility between 20-a and 20-b doses that differ only in straw color

Bull	n	20-a %	20-b; %	Range
D	385	46.4	41.5	4.9
E	387	44.7	45.2	0.5

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USE OF CASA AND FLOW CYTOMETRY TO IDENTIFY BULL FERTILITY DIFFERENCES

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OVERALL SUMMARY

- Sperm dose (10, 20 or 40 $\times 10^6$) per straw did not affect field fertility.
- A difference in bull fertility was detected.
- CASA and FC characteristics were different between bulls.
- CASA and FC were not able to explain the difference in field fertility between bulls.

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Breeding Soundness Evaluation (BSE)



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Should we "semen-test" or have a complete BSE performed?

What's the difference?

When should a BSE be done?



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Breeding Soundness Evaluation

- Physical examination
 - Eyes, feet, legs
 - Testes, epididymides, penis, prepuce
 - Seminal vesicles, prostate, ampullae
- Scrotal circumference
 - Association of paired testes and sperm production
- Semen collection and evaluation
 - Motility and morphology

Society for Theriogenology, 1992

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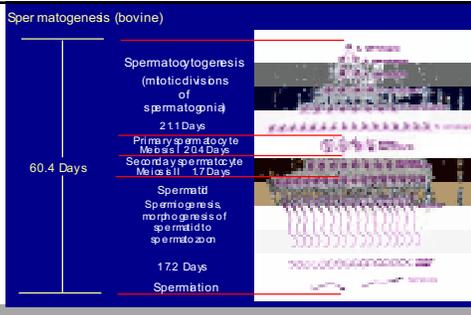
Breeding Soundness Evaluation

Classification:

- Satisfactory potential breeder:
 - Minimum criteria for scrotal circumference, sperm motility and morphology; free of physical problems
- Unsatisfactory potential breeder
- Deferred:
 - May improve with time; re-test in ~ 60 days

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Spermatogenesis (bovine)



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Why are BSE's important?

- 2,883 BSE's on beef bulls (2007-2017): 82% satisfactory, 15% deferred, 3% unsatisfactory
- 1,200 BSE's on beef and dairy bulls: 37% unsatisfactory
- 200 BSE's on Holstein bulls (12-15 mo): 36% unsatisfactory (57% of bulls failed because of the physical exam alone)

BSE benefit to cost ratio: \$20 for each \$1 invested

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Take Home Messages

- All sperm attributes necessary for fertilization and embryonic development are not known.
- Prediction of fertility has not occurred yet.



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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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Disclaimer

- Please read the proceedings paper for further information.
- Topics not included in the paper or presentation, but very important, include a discussion of:
 - fertility prediction vs. estimation (Utt, 2016)
 - bull nutrition and development (Barth, 2012)
 - social dominance (Chenoweth, 1981)



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