

Delayed insemination of non-estrous cows improves pregnancy rates when using sex-sorted semen in timed artificial insemination of suckled beef cows

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OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI
Background

- Doses of sex-sorted semen have lower fertility than doses of non-sex-sorted semen from the same bull
 - Lower overall sperm cell number per dose (~2 million versus ~20 million)
 - Compromised sperm quality as a result of the flow-cytometric sorting process
- As a result, sex-sorted semen appears to have lower overall fertility and/or a shorter fertile lifespan in the female reproductive tract

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI
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- Although widely used in the dairy industry, sex-sorted semen has seen little adoption by beef producers
 - Perceived cost compared to conventional semen
 - Higher cost per dose is compounded by lower fertility to create a higher cost per pregnancy
 - Opportunity cost of not having maximized first service pregnancies
 - Labor / time associated with heat detection
 - Use of sex-sorted semen in FTAI generally has been discouraged due to lower pregnancy rates
- In spite of the many potential applications for sex-sorted semen in the beef industry, the technology may not see widespread use without the development of a FTAI protocol that yields acceptably high pregnancy rates

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI
Background

- A previous joint research effort between the University of Missouri, Genex CRI, and the Ratcliff Ranch (Vinita, OK) evaluated the effect of extending the interval from PG to AI by 6 hr for heifers and 8 hr for cows when using sex-sorted semen
- This extended interval from PG to AI was not found to be advantageous for cows (n = 300)
- However, Estroject patches had been used to record estrus expression prior to FTAI, and differences in pregnancy rates between estrous and non-estrous cows raised important questions

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI
Background



Image courtesy LW-Madison Animal Sciences Department

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI
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Pregnancy rates of cows after FTAI			
Estrus	Conventional	Sex-sorted @ 66 hr	Sex-sorted @ 74 hr
Yes	69%	59%	48%
No	62%	18%	14%
Total	65%	36%	28%

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Background

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- When using sex-sorted semen, FTAI pregnancy rates were reduced among cows that had not expressed estrus prior to FTAI

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Background

- In FTAI, there are fundamentally **two groups of cows**
 - Cows having expressed estrus prior to FTAI (e.g. 66 hr after PG)**
 - Ovulate in response to an endogenous surge of LH
 - Ovulation occurs approximately 28-30 hr after the onset of estrus
 - Cows not having expressed estrus prior to FTAI**
 - Induced to ovulate in response to GnRH administration
 - Ovulation occurs approximately 28-30 hr after GnRH
- When using sex-sorted semen, sperm cells do not retain full fertility for 28-30 hr

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Background

- One potential solution is to utilize sex-sorted semen only on cows that have expressed estrus prior to FTAI
 - Cows not having expressed estrus could be inseminated with conventional semen
 - Cheaper cost per dose
 - Improved pregnancy rates to FTAI
- This approach would allow for an economical compromise by still achieving acceptable overall AI pregnancy rates
- However, this approach does not skew the calf gender ratio nearly as much as would be possible if sex-sorted semen could be utilized on non-estrous cows

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Experimental Aim and Hypothesis

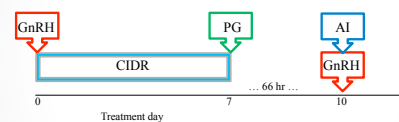
- Experimental aim: development of a strategy that would optimize the use of sex-sorted semen by better managing cows that do not express estrus prior to 66 hr
- Hypothesis: delayed insemination of non-estrous cows until 20 hr after GnRH would improve fertility by better aligning the window of sperm fertility with ovulation

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Experimental Design

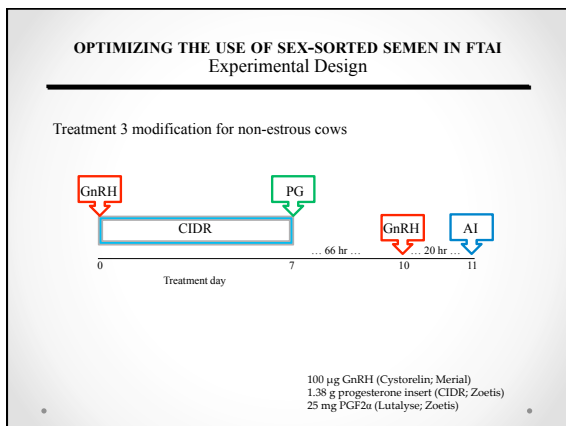
- 656 cows underwent estrous synchronization using a 7-Day CO-Synch + CIDR protocol
- EstroTECT heat detection patches were applied at CIDR removal
- Cows were assigned to one of three treatments:
 - Treatment 1:** Conventional (non-sex-sorted) semen with GnRH and AI at 66 hr regardless of estrus expression
 - Treatment 2:** Sex-sorted semen with GnRH and AI at 66 hr regardless of estrus expression
 - Treatment 3:** Sex-sorted semen with GnRH at 66 hr but AI time split based on estrus expression
 - Cows with activated EstroTECT patches received AI at GnRH (66 hr)
 - Cows with non-activated EstroTECT patches received AI 20 hr after GnRH

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Experimental Design

Standard 7-Day CO-Synch + CIDR



100 µg GnRH (Cystorelin; Merial)
1.38 g progesterone insert (CIDR; Zoetis)
25 mg PGF_{2α} (Lutalyse; Zoetis)



- ### OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Experimental Design and Statistical Analysis
- Treatments were equally represented across 5 groups/locations and 3 d of AI
 - Balanced for cow age and body condition score
 - AI performed by a single technician
 - A single sire was used for both sex-sorted and conventional semen
 - Statistical analyses
 - PROC TTEST (Age, BCS)
 - PROC GLIMMIX (Estrous response)
 - PROC FREQ (Pregnancy Rate)

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Results

Pregnancy rates			
Estrus	Conventional @ 66 hr	Sex-sorted @ 66 hr	Sex-sorted @ 66 hr with delay of non-estrous
Yes	77% ^a (81/105)	51% ^b (53/104)	42% ^b (47/111)
No	37% ^c (42/113)	2% ^d (3/113)	36% ^c (40/110)
Total	56% (123/218)	26% (56/217)	39% (87/221)
Estrous Response	48% (105/218)	48% (104/217)	50% (111/221)

- ### OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI Results
- | Pregnancy rates | | | |
|-----------------|---------------------------|---------------------------|--|
| Estrus | Conventional @ 66 hr | Sex-sorted @ 66 hr | Sex-sorted @ 66 hr with delay of non-estrous |
| Yes | 77% ^a (81/105) | 51% ^b (53/104) | 42% ^b (47/111) |
| No | 37% ^c (42/113) | 2% ^d (3/113) | 36% ^c (40/110) |
| Total | 56% (123/218) | 26% (56/217) | 39% (87/221) |
- Treatment x estrous expression interaction ($P < 0.0001$)
 - Pregnancy rates within a row with different superscripts are different ($P < 0.0001$)

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- Among estrous cows, FTAI pregnancy rates to sex-sorted semen were lower than pregnancy rates to conventional semen

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- Among non-estrous cows inseminated at the standard time, FTAI pregnancy rates to sex-sorted semen were particularly low
 - Potentially due to insufficient sperm longevity given the 28 hr interval from GnRH to ovulation

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI

Results

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Total	56% (123/218)	26% (56/217)	39% (87/221)

- Delayed insemination of non-estrous females until 20 hr after GnRH yielded a higher pregnancy rate ($P < 0.0001$)
 - May better match optimum sperm fertility with ovulation

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI

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- Pregnancy rates for non-estrous cows receiving delayed insemination using sex-sorted are similar to rates achieved using conventional semen at 66 hr ($P = 0.9$)

Day Group	Estrus	Pregnancy rates		
		Conventional @ 66 hr	Sex-sorted @ 66 hr	Sex-sorted @ 66 hr with delay of non-estrous
Day 1 Group 1	Yes	71% (15/21)	60% (15/25)	57% (13/23)
	No	32% (12/37)	3% (1/34)	41% (14/34)
	Total	47% (27/58)	27% (16/59)	47% (27/57)
Day 1 Group 2	Yes	94% (16/17)	53% (7/13)	47% (7/15)
	No	45% (5/11)	7% (1/15)	23% (3/13)
	Total	75% (21/28)	29% (8/29)	36% (10/28)
Day 2 Group 1	Yes	77% (23/30)	42% (14/33)	46% (17/37)
	No	38% (13/34)	0% (0/32)	33% (11/33)
	Total	56% (36/64)	22% (14/65)	40% (28/70)
Day 3 Group 1	Yes	73% (16/22)	46% (6/13)	28% (5/18)
	No	38% (7/18)	0% (0/24)	45% (9/20)
	Total	57% (23/40)	16% (6/37)	37% (14/38)
Day 3 Group 2	Yes	73% (11/15)	55% (11/20)	28% (5/18)
	No	38% (5/13)	12% (1/8)	30% (3/10)
	Total	57% (16/28)	43% (12/28)	29% (8/28)

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OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI

Conclusion

- When using sex-sorted semen in standard FTAI, pregnancy rates are low for cows that have not expressed estrus prior to FTAI
 - Basis for previous recommendation that sex-sorted semen should not be used in conjunction with FTAI
- Delayed insemination of non-estrous cows until 20 hr after GnRH improves pregnancy rates when using sex-sorted semen
 - 34% increase (2% to 36%) in pregnancy rate of non-estrous cows
- Among non-estrous cows, pregnancy rates achieved using delayed insemination of sex-sorted semen were comparable to rates achieved using conventional semen at 66 hr

OPTIMIZING THE USE OF SEX-SORTED SEMEN IN FTAI

Acknowledgments

- Genex
 - Stan Lock
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- Zoetis (formerly Pfizer Animal Health)
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- University of Missouri
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 - Dr. Scott Poock, DVM
 - Dr. Michael Smith
 - Michael Schieffer
 - Laura Mooney



SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM
FTAI Service Sires and FTAI Pregnancy Rates

Most Heavily Utilized AI Sires	FTAI Exposed	FTAI Pregnant	FTAI Preg Rate
A	756	387	51%
B	319	157	49%
C	513	249	49%
D	517	318	62%
E	486	277	57%
F	395	199	50%
G	409	181	44%
H	256	145	57%
I	139	73	53%
J	209	141	68%
K	239	132	55%
L	192	113	59%



Pregnancy rates after FTAI based on estrous expression

Pregnancy rates		
	Estrous expression	
	Yes	No
Busch et al., 2008	123/164 (75%)	150/270 (56%)
Nash et al., 2012	91/124 (73%)	99/220 (45%)
Martin, 2012	103/150 (69%)	108/240 (45%)
Total (n=1168)	317/438 (72%)	357/730 (49%)

Previous results using conventional semen

Pregnancy rates after FTAI			
Sire	Estrus expression		Difference
	Yes (%)	No (%)	
A	74%	38%	36%
B	83%	59%	24%
C	72%	49%	23%
D	75%	63%	12%
E	72%	52%	20%
F	52%	51%	1%
G	85%	17%	68%

This spring.....

- Extensive field trials with cows & heifers using split-time AI based on estrus.
 - Heifers were synchronized using 14-day CIDR-PG
 - Cows were synchronized using 7-day CO-Synch + CIDR