

EVOLUTION AND APPLICATION OF ESTROUS SYNCHRONIZATION PROTOCOLS

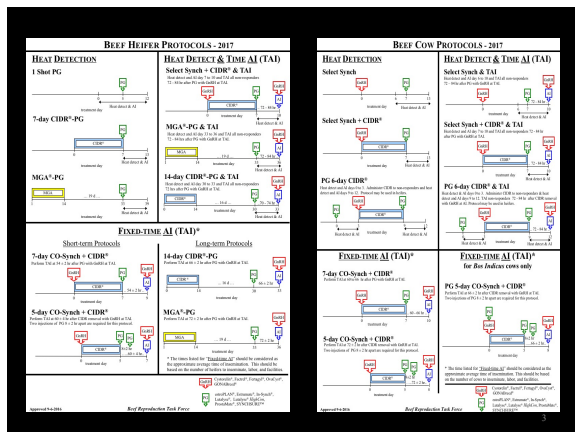


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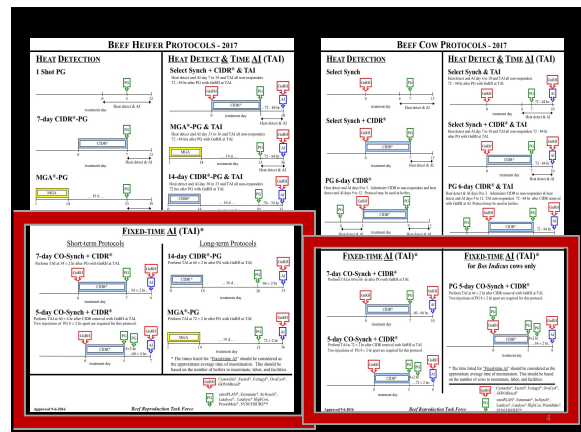
Development of Methods to Synchronize Estrus

DECADE	PHASE OF DEVELOPMENT
1950's – 60's	PROGESTERONE Inhibited estrus & ovulation; prolonged luteal phase; created artificial luteal phase
1970's	PROGESTERONE -ESTROGEN Norgestomet & estradiol valerate (Synervo-Mate B)
	PROSTAGLANDIN Prostaglandin F _{2α} and its analogs were found to be luteolytic
1980's	PROGESTIN - PROSTAGLANDIN MGA-PG
1990's	GnRH - PROSTAGLANDIN Ultrasound led to the understanding of follicular waves, Ov-synch; Select Synch; CO-Synch
2000's	PROGESTIN - GnRH - PROSTAGLANDIN

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Since 2005

Heat detection

- Cows
- PG 6-d CIDR

Heat detect & time AI

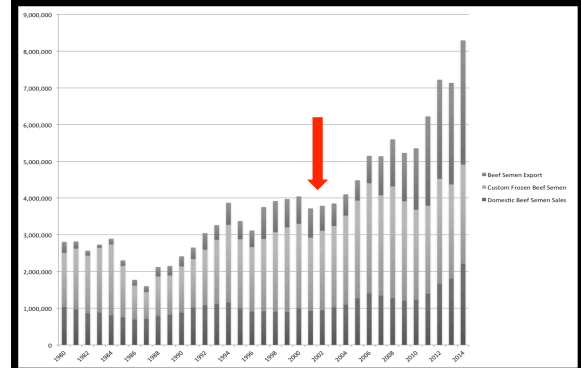
- Heifers
- 14-d CIDR-PG & TAI
- Cows
- PG 6-d CIDR

Fixed-time AI

- Heifers
- 5-day CO-Synch + CIDR
- 14-d CIDR-PG
- Cows
- 5-day CO-Synch + CIDR
- PG 5-d CO-Synch + CIDR (*Bos indicus*)



Beef Semen Sales



Goals in developing FTAI protocols

➤ FTAI estrus synchronization protocols

- ✓ Easy to schedule and administer
- ✓ Reduce animal handling
- ✓ Result in a highly synchronized and fertile estrus and ovulation



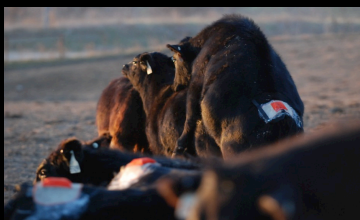
The next 30 minutes.....

➤ Overview of protocols

- Heifers
- 2-year-olds
- Mature cows
- Split-time AI



FIXED-TIME AI PROTOCOLS FOR HEIFERS



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HEIFERS FIXED-TIME AI

Short-term Protocols

7-day CO-Synch + CIDR®



Long-term Protocols

14-day CIDR®-PG



5-day CO-Synch + CIDR®



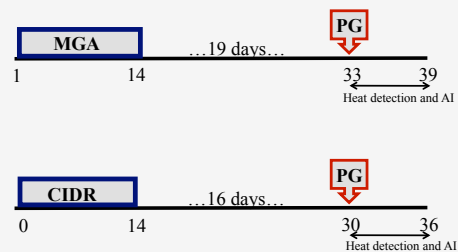
MGA®-PG



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HOW DO LONG-TERM PROTOCOLS COMPARE IN HEIFERS?

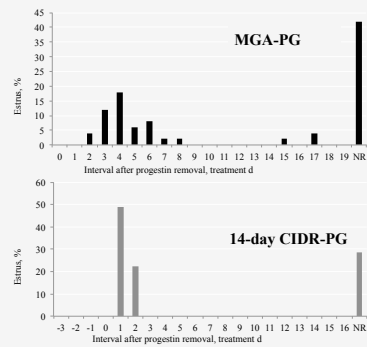
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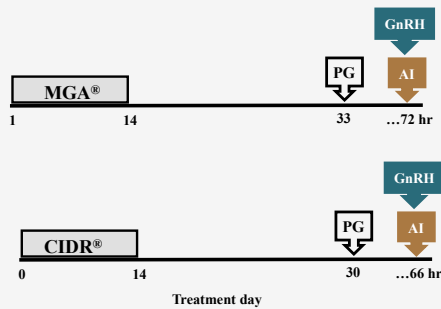
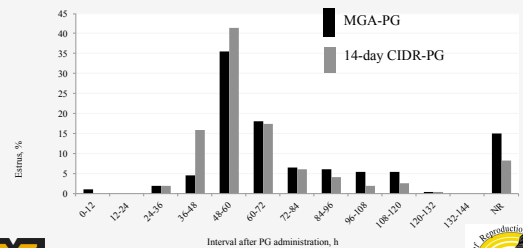
Mallory, et al., 2009



DISTRIBUTION OF ESTRUS AFTER MGA OR CIDR



DISTRIBUTION OF ESTRUS AFTER PG



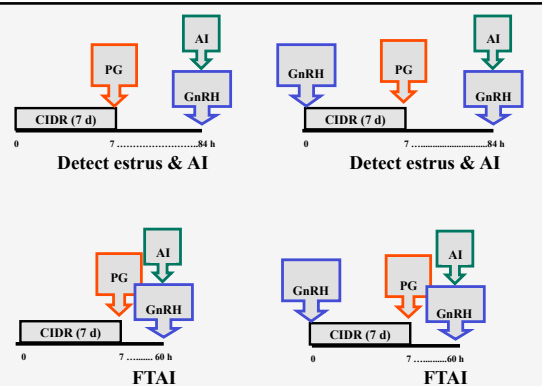
MGA-PG vs 14-DAY CIDR-PG

- Insemination performed on the basis of observed estrus
 - No differences in synchronized conception or pregnancy rates (Mallory et al., 2009)
- FTAI
 - No differences in pregnancy rates (Vraspir et al., 2013)

THE MULTI-STATE CIDR TRIAL

Lamb et al., 2006

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Lamb et al., 2006

MULTI-STATE CIDR TRIAL

- GnRH at CIDR insertion did not improve pregnancy rates after FTAI
- GnRH at CIDR insertion did not alter the percentage of heifers detected in estrus or the distribution of estrus after PG
- A combination of detecting estrus and AI before clean-up AI enhanced pregnancy rates over FTAI



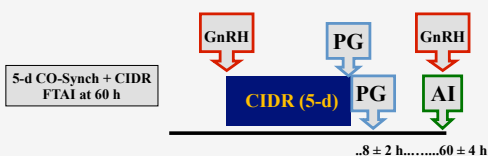
Lamb et al., 2006



5-DAY CO-SYNCH + CIDR

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5-DAY CO-SYNCH + CIDR



PREGNANCY RATES AFTER FTAI

Protocol comparison	Heifers (N)	Pregnancy rate (%)	P-value
7-day CO-Synch + CIDR vs 5-day CO-Synch + CIDR	292 ¹ vs 665 ²	52 vs 47	0.09 vs 0.05
14-day CIDR-PG vs 5-day CO-Synch + CIDR	303 ³ vs 524 ⁴	70 vs 53	> 0.10 vs 0.13
	1887 ⁵	55 vs 56	> 0.10

Ahmadzadeh et al., 2010¹; Sparks et al., 2012²; Bridges and Lake, 2011³; Perry et al., 2012⁴; Kasimanickam and Whittier, 2013⁵

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Are your heifers ready to synchronize?



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Heifer Management

- Heifers that conceive earlier during their first breeding season
- Stay in the herd longer
- Produce more pounds of beef over their lifetime



Reproductive management prior to the first breeding season

- Health platform
- Prebreeding evaluation
 - Target weight
 - **Reproductive tract scores (RTS)**
 - Pelvic measurements
- Estrous synchronization
- Sire selection (BW or CE EPD)



Reproductive Tract Scores

RTS	Cycling status	Uterine horns	Ovaries
1	infantile	no tone	no palpable follicles
2	non-cycling > 30 d to puberty	no tone	8 mm follicles
3	non-cycling < 30 d to puberty	slight tone	8-10 mm follicles
4	Estrous cycling Follicular phase	coiled	> 10 mm follicles
5	Estrous cycling Luteal phase	distended	corpus luteum present

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Reproductive Tract Scores

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Heifer Management

- RTS: 4 to 6 weeks before breeding or 2 weeks before estrous synchronization
- Begin synchronization when $\geq 50\%$ of the heifers have RTS of 4 or 5



MISSOURI – FIELD DATA SHOW-ME-SELECT™ REPLACEMENT HEIFER PROGRAM



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Reproductive Tract Scores and FTAI

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► Show-Me-Select database allows for analysis of FTAI pregnancy rates based upon reproductive tract score (n=29,343)

	1	2	3	4	5
n pregnant	9	255	4,091	5,138	5,088
n exposed	163	893	8,422	10,092	9,773
FTAI PR	6%	29%	48%	51%	52%

Reproductive Tract Scores and FTAI n = 9,315

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RTS and FTAI Pregnancy Rate		
FTAI Protocol	Non-Cycling	Cycling
7-Day CO-Synch + CIDR	166/438 38% ^{a,x}	369/861 43% ^{a,y}
MGA - PG	81/230 35% ^{a,x}	265/564 47% ^{a,y}
14-Day CIDR - PG	4,027/8,647 47% ^{a,y}	9,588/18,434 52% ^{a,y}

^aPercentages within rows with different superscripts differ P < 0.01.
^{x,y}Percentages within columns with different superscripts differ P < 0.01.

Reproductive Tract Scores and FTAI n = 19,859

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RTS and FTAI Pregnancy Rate		
FTAI Protocol	Non-Cycling	Cycling
7-Day CO-Synch + CIDR	166/438 38% ^{a,x}	369/861 43% ^{a,y}
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^{x,y}Percentages within columns with different superscripts differ P < 0.01.

Reproductive Tract Scores and FTAI n = 29,174 heifers

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RTS and FTAI Pregnancy Rate			
FTAI Protocol	Non-Cycling	Cycling	Totals
7-Day CO-Synch + CIDR	166/438 38% ^{a,x}	369/861 43% ^{a,y}	535/1,299 41% ^a
MGA - PG	81/230 35% ^{a,x}	265/564 47% ^{a,y}	346/794 44% ^a
14-Day CIDR - PG	4,027/8,647 47% ^{a,y}	9,588/18,434 52% ^{a,y}	13,615/27,081 50% ^a

^aPercentages within rows with different superscripts differ P < 0.01.
^{x,y}Percentages within columns with different superscripts differ P < 0.01.

14-DAY CIDR-PG PROTOCOL FOR HEIFERS



Combining health & reproduction in a single management step.....



TAKE HOME POINTS...
HEIFERS

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TAKE HOME POINTS

- The protocols work.....
- Choosing a protocol for FTAI in heifers
 - Consider pre-treatment estrous cyclicity status
 - RTS 4 to 6 weeks before breeding
- Protocol compliance will determine success
 - Product administration
 - Timing of insemination



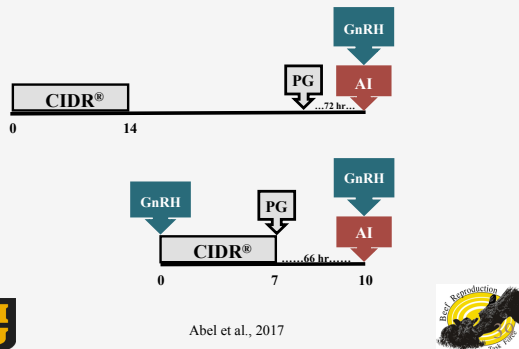
WHAT ABOUT 2-YEAR-OLDS?

How do short- versus long-term CIDR-based protocols compare?

Abel et al., 2017

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Treatments



Locations.....

Montana Correctional Enterprises Ranch
•Deer Lodge, Montana

La Cense Montana Ranch
•Dillon, Montana

MU Thompson Research Center
•Spickard, Missouri



Abel et al., 2017



Estrous Response

	14-d CIDR-PG		7-d CO-Synch + CIDR	
	Proportion	%	Proportion	%
Location 1	10/19	53	10/18	56
Location 2	45/108	42 ^a	77/105	73 ^b
Location 3	31/104	30 ^a	69/106	65 ^b
Location 4	66/124	53 ^a	103/120	86 ^b
Total	152/355	43^a	259/349	74^b

^{a-b} Estrous response rates within rows differ, $P < 0.0001$



Abel et al., 2017



Pregnancy rates after FTAI

	14-d CIDR-PG		7-d CO-Synch + CIDR	
	Proportion	%	Proportion	%
Location 1	14/19	74	10/18	56
Location 2	66/108	61	74/105	71
Location 3	65/104	63	57/106	54
Location 4	78/104	63	81/120	68
Total	223/355	63	222/349	64



Abel et al., 2017



Final Pregnancy

Pregnancy rate	14-d CIDR-PG		7-d CO-Synch + CIDR	
	Proportion	%	Proportion	%
AI Pregnancy	223/355	63	222/349	64
Pregnant within 30 d	308/355	87	307/349	88
Pregnant by end of the breeding season	339/355	95	334/349	96



Abel et al., 2017



Conclusions

- The 14-d CIDR-PG and 7-d CO-Synch + CIDR protocols effectively synchronize estrus prior to FTAI in primiparous two-year-old postpartum beef cows
- Implementation of a progestin-based estrus synchronization protocol can increase the proportion of females that conceive early in the breeding season



Photo by Montana Stockgrowers Association



Abel et al., 2017



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FIXED-TIME AI PROTOCOLS FOR COWS

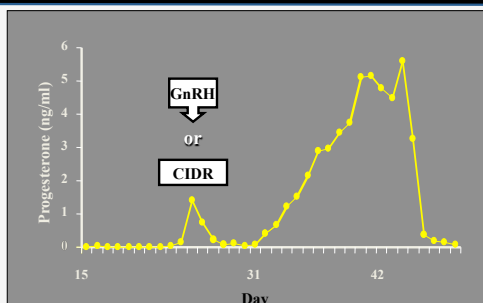


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Dealing with Anestrus



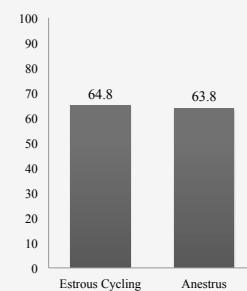
Induction of estrus and ovulation



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FTAI Pregnancy rate in Anestrous Cows

- 2,341 cows
 - 4 Studies
 - Bader et al., 2005
 - Schafer et al., 2007
 - Busch et al., 2008
 - Wilson et al., 2010
 - Estrous Cycling
 - 1329/2341 = 57%
 - Anestrus
 - 1012/2341 = 43%



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FIXED-TIME AI FOR COWS

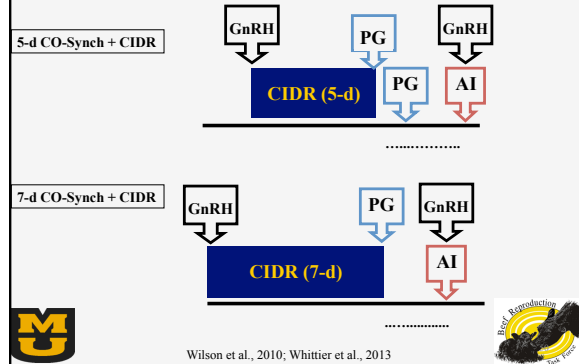
7-day CO-Synch + CIDR®



5-day CO-Synch + CIDR®



5-AND 7-DAY COMPARISON



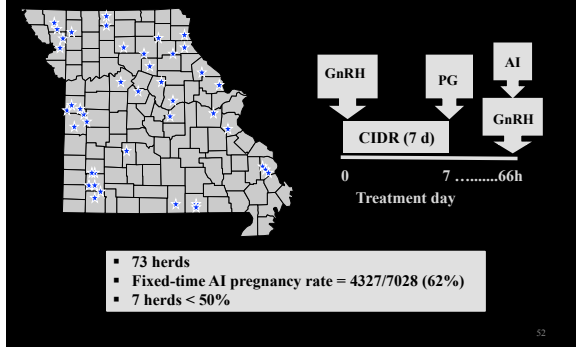
Pregnancy rates resulting from FTAI in cows

Treatment	Time of AI	Pregnancy rate	
7-day CO-Synch + CIDR	FTAI @ 66 hr	140/209	67%
	FTAI @ 69 hr	498/906	55% ^a
5-day CO-Synch + CIDR	FTAI @ 72 hr	140/210	67%
	FTAI @ 72 hr	528/911	58% ^b

Wilson et al., 2010; Whittier et al., 2013; ^aP<0.05



On-farm Demonstrations with Fixed-time AI in Postpartum Beef Cows



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Pregnancy rates resulting from FTAI in cows

Treatment	Time of AI	Pregnancy rate	
7-day CO-Synch + CIDR ¹	FTAI @ 66 hr	4327/7028	62
5-day CO-Synch + CIDR ²	FTAI @ 72 hr	1357/2189	62

¹Patterson et al., 2009

²Johnson et al., 2010



TAKE HOME POINTS

Wilson et al., 2010; Whittier et al., 2013

- When considering a choice between the 5-d and 7-d protocols
- Both protocols work effectively in postpartum beef cows, with evidence of up to a 3% advantage to the 5-d protocol.
- Beef producers must carefully consider the increased labor and treatment costs associated with the 5-d protocol.



TAKE HOME POINTS

- The protocols work.....
- Choosing a protocol for FTAI in cows
 - Cow age
 - Average number of days postpartum
 - Body condition
- Protocol compliance will determine success
 - Product administration
 - Timing of insemination



CAN HIGHER PREGNANCY RATES BE ACHIEVED WITH SPLIT-TIME AI?

Thomas et al., 2014

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CONSIDER FEMALE FERTILITY IN FTAI

- Among females that exhibit estrus prior to FTAI
 - Differences in when females express estrus up to the point of FTAI
 - Differing intervals from estrus to ovulation
- Among females that don't exhibit estrus prior to FTAI
 - GnRH induces LH surge within 2 to 4 hr
 - Ovulation will then be induced 24-32 hr after GnRH

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ESTRUS AND FEMALE FERTILITY

- Estradiol increases prior to estrus
 - Coordinates physiological processes that contribute to the establishment and maintenance of pregnancy
- Cows exhibiting estrus prior to FTAI have greater serum estradiol concentrations
- Higher pregnancy rates are achieved by females that express estrus prior to FTAI



(Perry and Smith, 2015)



IS IT WORTH CONSIDERING A MODIFIED APPROACH?

- Can male FTAI fertility be optimized by **differentially managing females based on estrus expression** prior to FTAI?
- Could fertility be improved by **splitting the AI time for estrous and non-estrous females**?



Thomas et al., 2014



SPLIT-TIME AI TRIALS

- **Experimental Aim:** Development of a strategy that would optimize fertility by better managing females that do not express estrus prior to FTAI
- **Hypothesis:** Delaying insemination of non-estrous females until 20-24 h after GnRH would improve fertility by better aligning the window of sperm fertility with ovulation



Thomas et al., 2014



SPLIT-TIME AI TRIALS — Thomas et al., 2014

1. Split-time AI to optimize the use of sex-sorted semen
2. Split-time AI using conventional semen in heifers
3. Split-time AI using conventional semen in cows



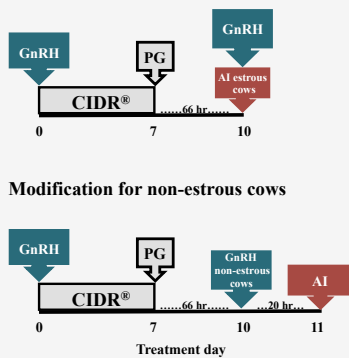
ESTRUS DETECTION



- ESTROTECT™ estrus detection aids applied at PGF_{2α} administration
- Activation of estrus detection aid evaluated at time of FTAI

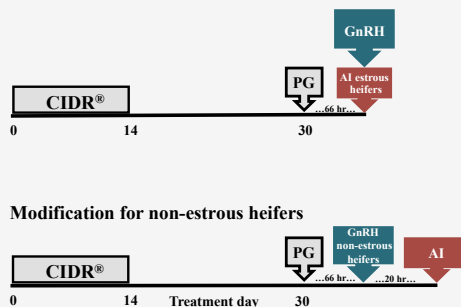


COW PROTOCOLS — (7-D CO-SYNCH + CIDR)



Thomas et al., 2014

HEIFER PROTOCOLS — (14-D CIDR-PG)



Thomas et al., 2014

SPLIT-TIME AI TRIALS — Thomas et al., 2014

- Split-time AI increased pregnancy rates by 34% among non-estrous cows inseminated with sex-sorted semen.
- Split-time AI increased pregnancy rates by 15% among non-estrous heifers using conventional semen.
- No significant improvement in pregnancy rates were observed with split-time AI using conventional semen in non-estrous cows.



DOES TIMING OF GnRH
ADMINISTRATION AFFECT ESTRUS
RESPONSE AND/OR AI PREGNANCY
RATES FOLLOWING STAI?

Bishop et al., 2017

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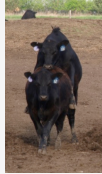
WHEN CONSIDERING STAI

- It is not necessary to administer GnRH to heifers or cows that express estrus up to 66 or 90 h after PG

- 14-d CIDR-PG in heifers
- 7-d CO-Synch + CIDR in cows

- GnRH may be administered concurrent with AI for heifers or cows that fail to express estrus prior to 90 h

- Minimizing use of GnRH results in a greater overall estrous response in cows



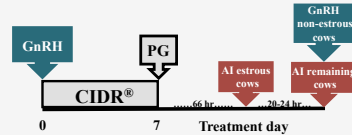
Bishop et al., 2017



14-d CIDR-PG with STAI (heifers)



7-d CO-Synch + CIDR with STAI (cows)



Bishop et al., 2017

WHERE DO WE GO FROM HERE?

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WHERE DO WE GO FROM HERE?

➤ RESEARCH

- Continued development and evaluation of protocols to expand opportunities to utilize FTAI or STAI in *Bos indicus* influenced females
- Development of breeding strategies that facilitate use of sex-sorted semen in beef cows and heifers in conjunction with FTAI or STAI
- Begin efforts to elicit differences among bulls on the basis of pregnancy rates resulting from FTAI



WHERE DO WE GO FROM HERE?

➤ TECHNOLOGY TRANSFER

- Expand efforts to transfer reproductive technologies to the beef industry
- Applied Reproductive Strategies in Beef Cattle
- Emphasize use of these technologies in undergraduate, graduate, and veterinary curricula (internships)
- Expand linkages with practicing veterinarians



ACKNOWLEDGEMENTS

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ACKNOWLEDGEMENTS

- BEEF REPRODUCTION TASK FORCE
- BEEF REPRODUCTION LEADERSHIP TEAM



ACKNOWLEDGEMENTS



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