CONTROL OF ESTRUS AND OVULATION IN BEEF HEIFERS AND COWS

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The U.S. beef industry …

Challenges……

- Aging producer population
- A segmented industry steeped in tradition
- Rising input costs
- Declining inventory
- Increasing global competition
- Perceived lack of incentives

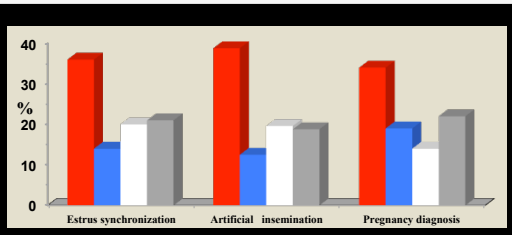
The U.S. beef industry …

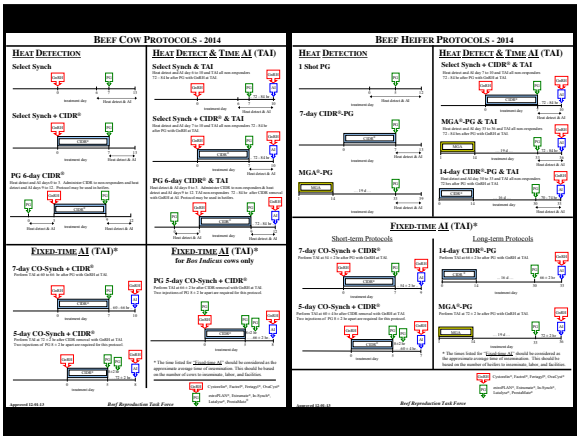
Opportunities……..

- On-the-shelf technology not being used *(that works)*
- Increasing domestic & global demand for high-quality beef
- Marketing incentives that will add value

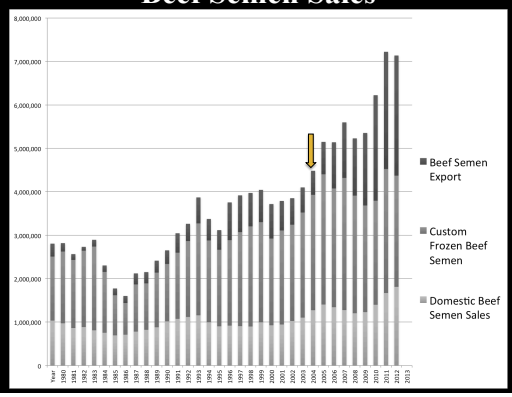
Reasons Beef Producers in the U.S. Cite for not Using Reproductive Procedures

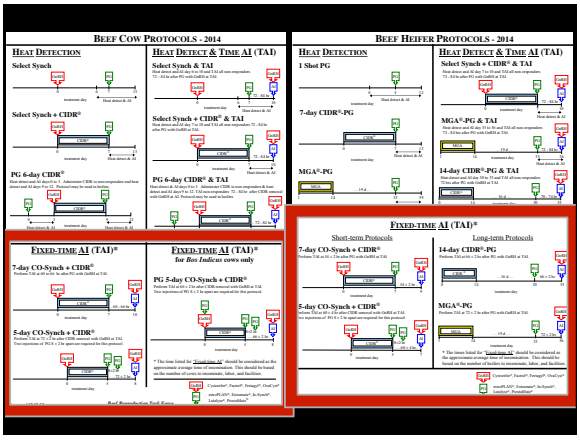
(NAHMS, 2008)





Beef Semen Sales



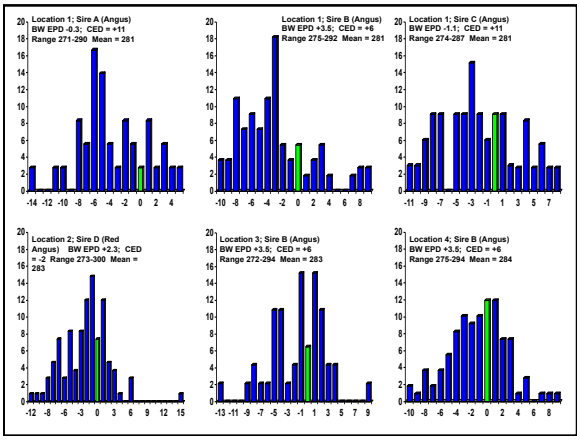


The next 45 minutes…..

- **Management considerations related to FTAI**
  - Heifers and Cows
- **Overview of protocols**
  - Heifers and Cows
- **Questions and discussion - tonight**

Management Considerations Related to Estrus Synchronization & **FIXED-TIME AI**

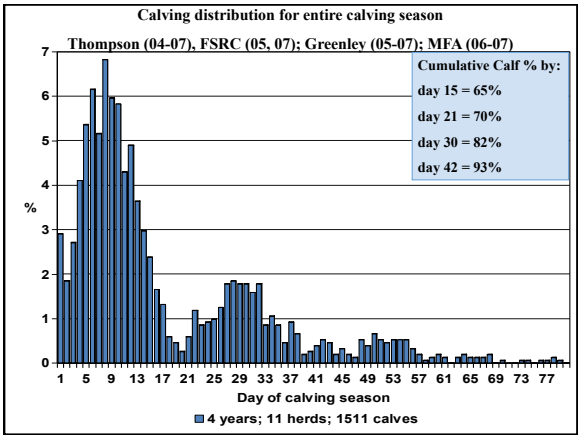
Do we know what to expect at calving from cows that conceive on the same day to the same sire?

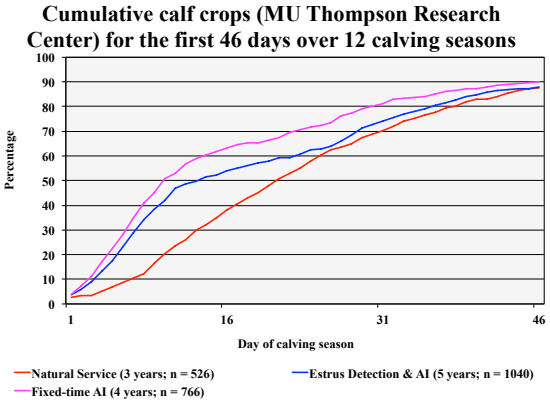


Consider the impact of estrus synchronization on calving distribution……

Hughes, 2005

- Opportunities for increasing profits lie in managing females from the later calving intervals forward toward the first and second calving intervals.
- High production herds see 61% of the calves born by day 21, 85% by day 42 and 94% by day 63.





Objective: Development of highly effective & economical estrus synchronization programs

- Replacement heifers & postpartum beef cows
  - Cycling & non-cycling
- Excellent pregnancy rates
- Reduced AI period and/or fixed-time AI

Considerations Related to Heifer Management

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

1. Target weight
2. Reproductive tract scores (RTS)
3. Pelvic measurements
4. Estrous synchronization
5. 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	cycling	coiled	> 10 mm follicles
5	cycling	distended	corpus luteum present

Reproductive Tract Scores

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5	cycling	distended	**corpus luteum present**

Neonatal exposure to progesterone and estradiol on reproductive tract in beef heifers

	Age at Treatment[b]			
Response[a]	Birth	Day 21	Day 45	Control
Uterocervical weight[c] (g)	113.7[d]	123.5[d]	101.3[d]	173.9[e]
Myometrial area (mm^2)	123.7[g]	141.8[g]	111.3[g]	162.8[h]
Endometrial area (mm^2)	29.9[i]	32.4[i]	37.7[i]	45.4[j]
Gland density (hits/mm^2)	172.2[d]	380.3[e]	382.2[e]	486.9[f]
Uterine luminal protein (mg/flush)	2.8[d]	2.9[d]	2.3[d]	4.9[e]

Heifer Management

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

Why use estrous synchronization?

Why use estrous synchronization?

- More heifers will become pregnant early during the breeding season
  - Progestin-based programs can induce estrous cyclicity in pre- or peripubertal heifers (MGA, or CIDR)

Pregnancy rates of heifers in natural service versus synchronized and AI'ed herds

	Exposed		21-d pregnancy rate	
RTS	NS[1] (n)	SAI[2] (n)	NS (%)	SAI (%)
1	8	55	38[a]	42[a]
2	108	661	31[a]	52[b]
3	336	3320	41[a]	58[b]
4	322	3629	48[a]	62[b]
5	242	2835	50[a]	64[b]
Total	1,016	10,500	44[a]	61[b]

[1, 2]NS=natural service; SAI= synchronized and AI'ed
[a, b]P< .05
Adapted from Randle and Patterson, 2005

FIXED-TIME AI PROTOCOLS FOR HEIFERS

FIXED-TIME AI

Short-term Protocols

7-day CO-Synch + CIDR®

5-day CO-Synch + CIDR®

Long-term Protocols

14-day CIDR®-PG

MGA®-PG

How do the long-term protocols compare in heifers?

FIXED-TIME AI

Short-term Protocols

7-day CO-Synch + CIDR®

5-day CO-Synch + CIDR®

Long-term Protocols

14-day CIDR®-PG

MGA®-PG

MGA-PG

- MGA-PG was the preferred method of estrus synchronization in beef heifers (Brown et al., 1986; Deutscher et al., 2000; Lamb et al., 2000).

MGA … 17 to 19 days … PG

1 14 33

Treatment day

14-d CIDR-PG protocol for heifers

CIDR® PG GnRH AI

0 14 30 …66 hr

Treatment day

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

Treatments

MGA …19 days… PG

1 14 33 39

Heat detection and AI

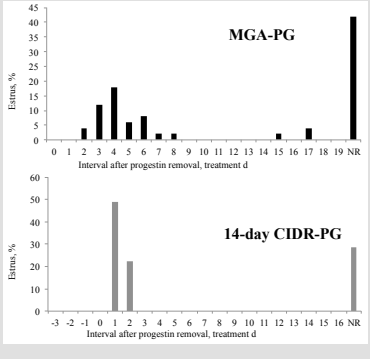
CIDR …16 days… PG

0 14 30 36

Heat detection and AI

Mallory, et al., 2009

Estrous distribution after MGA or CIDR



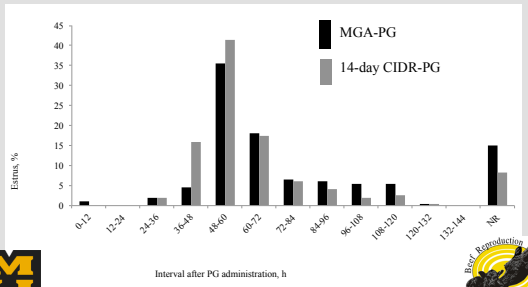
Mean interval to estrus and variance for interval to estrus after MGA or CIDR

	Treatment	
	MGA-PG	14-day CIDR-PG
Overall mean interval to estrus, h	134.3 ± 12.6[a]	37.8 ± 11.2[b]
Variance for interval to estrus	9172[a]	136[b]

[a,b] Means within rows with different superscripts differ ($P < 0.01$)

Mallory, et al., 2009

Distribution of estrus after PG



Mean interval to estrus and variance for interval to estrus after PG

	Treatment	
	MGA-PG	14-day CIDR-PG
Overall mean interval to estrus, h	57.4 ± 2.5	56.2 ± 2.5
Variance for interval to estrus after PG	466[a]	282[b]

[a,b] Means within rows with different superscripts differ ($P = 0.01$)

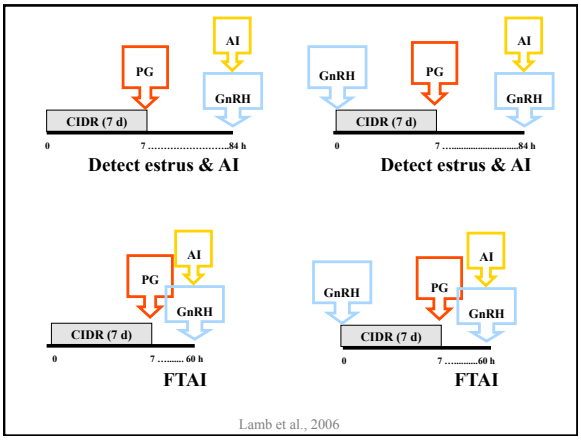
Mallory, et al., 2009

Conclusion

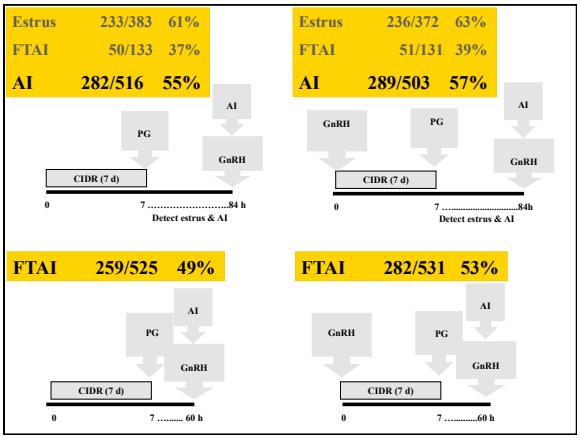
- When heifers were inseminated on the basis of observed estrus, there were no differences between treatments for synchronized conception or pregnancy rates, despite the improvement in synchrony of estrus after PG among CIDR-treated heifers (Mallory et al., 2009).
- Pregnancy rates after FTAI, did not differ between treatments (Vraspir et al., 2013).

The Multi-State CIDR Trial

Lamb et al., 2006



Lamb et al., 2006



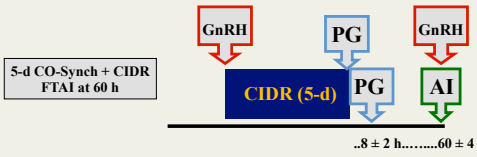
Multi-state CIDR Trial

- 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

5-d CO-Synch + CIDR



Bridges et al., 2008

Pregnancy rates after FTAI

Experiment	Comparisons	N	PR, %	P value
Ahmadzadeh et al., 2010	**7-d CO-Synch + CIDR**	147	52.0	**0.09**
	5-d CO-Synch + CIDR	145	62.5	
Bridges & Lake, 2011	14-d CIDR Select	153	70.4	> 0.10
	5-d Select-Synch + CIDR	150	70.4	
Sparks et al., 2012	**7-d Select Synch + CIDR**	297	47.3[a]	**< 0.05**
	5-d Select Synch + CIDR	368	57.1[b]	
Perry et al., 2012	14-d CIDR-PG	257	53.3	= 0.13
	5-d CO-Synch + CIDR	267	62.5	
Kasimanickam and Whittier, 2013 unpublished	14-d CIDR-PG	897	54.5	> 0.10
	5-d CO-Synch + CIDR	990	55.5	

Show-Me-Select™ Replacement Heifer Program

Field data from Missouri

Show-Me-Select Replacement™ Heifer Program
Reproductive tract score and subsequent FTAI pregnancy rate

- A summary of **RTS** and **FTAI pregnancy rate** for **14,510** heifers evaluated from Spring 2010 - Spring 2014.

RTS	1	2	3	4	5
n pregnant	8	159	1896	2274	2801
n exposed	78	492	4079	4533	5322
FTAI PR	**10%**	**32%** [a]	**46%** [b]	**50%** [c]	**53%** [d]

Values within row with different superscripts differ at $P \leq 0.05$

Show-Me-Select Replacement™ Heifer Program
Reproductive tract score and subsequent FTAI pregnancy rate

	RTS and FTAI Pregnancy Rate					
FTAI Protocol	**1**	**2**	**3**	**4**	**5**	**Total**
7-Day CO-Synch + CIDR	0/3 **0%**	15/56 27%	82/224 37%	117/288 41%	117/254 46%	331/825 40%
MGA - PG	0/3 **0%**	2/9 22%	79/221 36%	165/388 43%	100/176 57%	346/797 43%
14-Day CIDR - PG	8/72 **11%**	142/427 33%	1735/3634 48%	1992/3857 52%	2584/4892 53%	6461/12882 50%

7-Day CO-Synch + CIDR: $n = 825$ MGA - PG: $n = 797$ 14-Day CIDR - PG: $n = 12,882$

Show-Me-Select Replacement™ Heifer Program
Reproductive tract score and subsequent FTAI pregnancy rate

	Pre-Breeding Cyclicity Status and FTAI Pregnancy Rate		
FTAI Protocol	**Non-Cycling**	**Cycling**	**Total**
7-Day CO-Synch + CIDR	97/280 **35%** [a]	234/542 43% [c]	331/822 40% [x]
MGA - PG	81/230 **35%** [a]	265/564 47% [c]	346/794 43% [x]
14-Day CIDR - PG	1877/4061 **46%** [b]	4576/8749 52% [d]	6453/12810 50% [y]

Values within columns with different superscripts differ at $P \leq 0.05$

Show-Me-Select Replacement™ Heifer Program
Reproductive tract score and subsequent FTAI pregnancy rate

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Show-Me-Select Replacement™ Heifer Program
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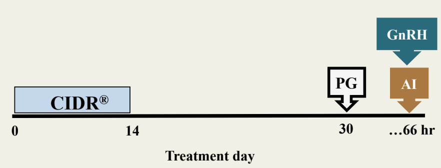
14-d CIDR-PG protocol for heifers



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

Sent: Friday, October 12, 2012 12:24 PM
To: Patterson, David J.
Subject: Bryansk Meat Company, Bryansk, Russia

Dave,

We completed the 14-day CIDR-PG program and insemination of about 42,000 heifers over roughly 24 days. Things went really well except for some minor issues. We stayed on schedule the entire time. We did not mix groups which was also a huge concern with stockmen with little experience and 140 groups of about 300 heifers to keep track of. We usually finished 30 minutes ahead of schedule using 3-4 inseminators.

Placing heifers in 1200 head groups during the CIDR implantation period and then dividing them into 4 groups of 300 at PG worked fine. We placed heat detection patches on 8 different groups and consistently identified 82-88% of the heifers responding by 66 hours post PG injection.

We have ultrasounded 5 farms to date, about 15,000 heifers. So far the AI conception rate has consistently been 60-61% which I consider very acceptable considering the size of the project and using some inexperienced personnel. I have no reason to believe that the remaining farms will not have a similar AI conception rate.

Thank you for your help and interest.

Take home points… HEIFERS

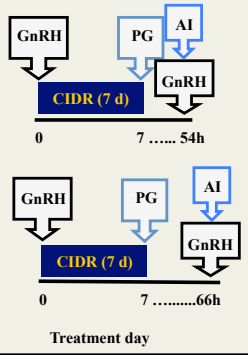
Take Home Points

- **The protocols work**……
- Choosing a protocol for use in synchronizing beef heifers prior to fixed-time AI should include consideration of the **pre-treatment estrous cyclicity status** of heifers *4 to 6 weeks before breeding*.
- Careful attention to **protocol compliance**, specifically *product administration* and *timing of insemination* are critical determinants of success.

FIXED-TIME AI PROTOCOLS FOR COWS

Does timing of insemination really matter?

CO-Synch + CIDR with FTAI at 54 or 66 h



Pregnancy rates to fixed-time AI

Busch et al., 2008

Treatment	Pregnancy rate No.	Pregnancy rate %
FTAI at 54hr	257/424	61[x]
FTAI at 66hr	286/426	67[y]

[x,y] $P = 0.05$

Interval from PG to FTAI

Busch et al., 2008

	54 h	66 h
Mean	54.2	66.2
SD	0.5	0.4
Range	2.3 h	2.3 h

Estrous response between treatments (Loc 2)

Busch et al., 2008

Treatment	Estrous response No.	Estrous response %
FTAI at 54h	57/218	26[x]
FTAI at 66h	107/216	50[y]

[x,y] $P < 0.01$

Pregnancy rate based on estrous response and time of AI (Location 2)

Busch et al., 2008

	54 h		66 h	
Estrous response	Pregnancy rate		Pregnancy rate	
Exhibited estrus	37/57	65%[a]	86/106	81%[b,x]
DID NOT exhibit estrus	87/161	54%	63/109	58%[y]

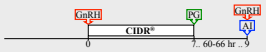
[a,b] $P < 0.05$
[x,y] $P < 0.01$

Summary

- More cows ($P < 0.01$) exhibited estrus prior to FTAI when AI was performed at 66 h compared to 54 h.
- Cows that exhibited estrus prior to FTAI had higher ($P < 0.01$) pregnancy rates than cows that did not exhibit estrus.

FIXED-TIME AI for Cows

7-day CO-Synch + CIDR®

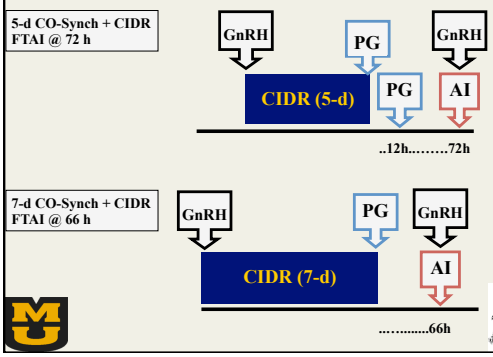


5-day CO-Synch + CIDR®

How do the 5-d and 7-d CO-Synch + CIDR protocols compare on the basis of pregnancy rates resulting from fixed-time AI in postpartum beef cows?

5-d and 7-d comparison

Wilson et al., 2010



Fixed-time AI and final pregnancy rates

Wilson et al., 2010

Location	Treatment	Fixed-time AI		Final	
		No.	%	No	%
1	5-d	36/60	60	57/60	95
	7-d	38/58	66	57/58	98
2	5-d	72/100	72	99/100	99
	7-d	73/102	72	97/102	95
3	5-d	32/50	64	45/50	90
	7-d	29/49	59	46/49	94
Combined	**5-d**	140/210	**67**	201/210	**96**
	7-d	140/209	**67**	200/209	**96**

Pregnancy rate between treatments and by estrous cyclicity status

Wilson et al., 2010

	5-d CO-Synch + CIDR				7-d CO-Synch + CIDR			
	Estrous cycling		Anestrus		Estrous cycling		Anestrus	
Location	Proportion	%	Proportion	%	Proportion	%	Proportion	%
1	34/55	62	2/5	40	35/53	66	3/5	60
2	31/38	82	41/62	66	27/41	66	45/61	74
3	20/29	69	12/21	57	20/34	59	9/15	60
Combined	85/122	**70**	55/88	**63**	82/128	**64**	57/81	**70**

Pregnancy rates resulting from FTAI in cows[1]

Treatment	Time of AI	Pregnancy rate	
7-day CO-Synch + CIDR	FTAI @ 69 hr	498/906	55%[a]
5-day CO-Synch + CIDR	FTAI @ 72 hr	528/911	58%[b]

[1]Whittier et al., 2013
[a,b]P<0.05

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

[1]Patterson et al., 2009
[2]Johnson et al., 2010

Take Home Points

- 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.

Bridges et al., 2008; Wilson et al., 2010; Whittier et al., 2013

Take Home Points

- **The protocols work**……
- **Choosing a protocol** for use in synchronizing **beef cows** prior to fixed-time AI should include consideration of the *age of the cows, average number of days postpartum* at treatment administration, and *body condition*.
- Careful attention to **protocol compliance**, specifically *product administration* and *timing of insemination* are critical determinants of success.

Split-time AI

Estrous Expression Prior to Fixed-time AI

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

Estrous Expression Prior to Fixed-time AI

Are differences in pregnancy rates bull dependent?

Pregnancy rates after FTAI			
	Estrus expression		
Sire	Yes	No	Difference
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%

Sires A-D: Busch et al., 2008 Sires E-G: Martin, 2012

Estrous Expression Prior to Fixed-time AI

Are differences in pregnancy rates bull dependent?

Pregnancy rates after FTAI			
	Estrus expression		
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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%

Sires A-D: Busch et al., 2008 Sires E-G: Martin, 2012

Split-time AI Trials

Thomas et al., 2014

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

Split-time AI Trials

Thomas et al., 2014

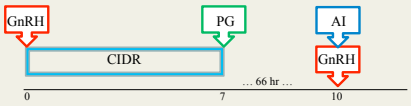
1. **Split-time AI to optimize the use of sex-sorted semen**
2. **Split-time AI using conventional semen in heifers**
3. **Split-time AI using conventional semen in cows**

In each trial……..

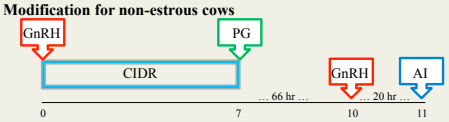
- **ESTROTECT™ estrous detection aids were applied at PG administration**
- **Activation of estrous detection aid recorded at GnRH administration**

Cow Protocols

7-Day CO-Synch + CIDR



Modification for non-estrous cows

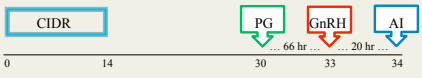


Thomas et al., 2014

Heifer Protocols

14-d CIDR-PG (Heifers)

Modification for non-estrous heifers



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.**

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