



## CONTROL OF ESTRUS IN HEIFERS

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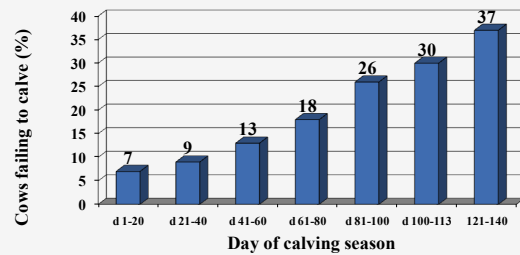
## Considerations Related to Heifer Management

### Heifer Management

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

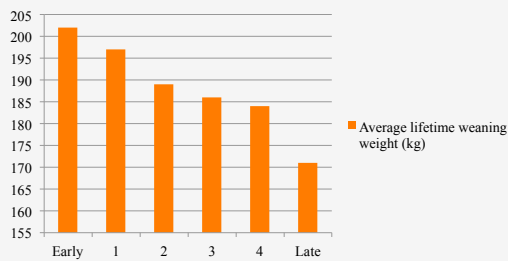


### Effect of calving date on the number of cows calving the subsequent year



(Borris and Pride, 1958)

### Relationship between time of calving and lifetime production of beef cows



Adapted from Lesmeister et al., 1973

### 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 management prior to the first breeding season

1. Target weight
2. Reproductive tract scores
3. Pelvic measurements
4. Estrous synchronization
5. Sire selection (BW or CE EPD)
  - Accuracies make a difference



## Prebreeding evaluation of heifers...

- Weight
- Reproductive tract scores
- Pelvic area



## Reproductive Tract Scores

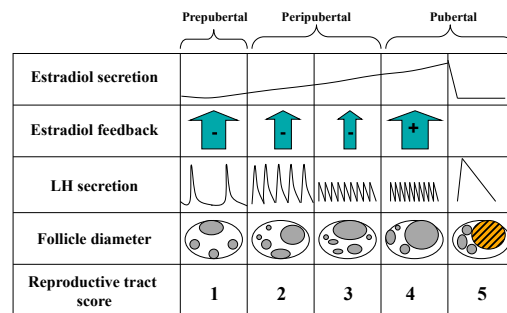
RTS	Uterine Horns	Ovarian Length (mm)	Ovarian Height (mm)	Ovarian Width (mm)	Ovarian Structures
1	Immature, <20 mm diameter, no tone	15	10	8	No palpable follicles
2	20-25 mm diameter, no tone	18	12	10	8 mm follicles
3	20-25 mm diameter, slight tone	22	15	10	8-10 mm follicles
4	30 mm diameter, good tone	30	16	12	> 10 mm follicles, CI possible
5	> 30 mm diameter	>32	20	15	Corpus luteum present



From Anderson et al., 1991



## Endocrine and Ovarian Changes Associated with Puberty Onset



Adapted from Day and Anderson, 1998; Anderson et al., 1991

## Reproductive Tract Score (RTS) Summary

RTS	n	Weight (lb)	Pelvic Height (cm)	Pelvic Width (cm)	Pelvic Area (cm <sup>2</sup> )	Estrous Response (%)
1 infantile	61	594 <sup>a</sup>	13.9 <sup>a</sup>	10.9 <sup>a</sup>	152 <sup>a</sup>	54 <sup>a</sup>
2 prepubertal (> 30 d from puberty)	278	620 <sup>b</sup>	14.1 <sup>a</sup>	11.2 <sup>a</sup>	158 <sup>a</sup>	66 <sup>b</sup>
3 prepubertal (< 30 d from puberty)	108	697 <sup>c</sup>	14.5 <sup>b</sup>	11.4 <sup>b</sup>	166 <sup>b</sup>	76 <sup>c</sup>
4 cycling (follicular phase)	494	733 <sup>d</sup>	14.7 <sup>c</sup>	11.7 <sup>c</sup>	172 <sup>c</sup>	83 <sup>d</sup>
5 cycling (luteal phase)	728	755 <sup>d</sup>	14.7 <sup>c</sup>	11.7 <sup>c</sup>	172 <sup>c</sup>	86 <sup>d</sup>

<sup>a, b, c, d</sup> Numbers with different superscripts within a column differ (P < 0.05)  
Patterson and Bullock, 2000



## SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM

- RTS and FTAI pregnancy rate for 5,126 heifers
  - Spring 2010 - Fall 2011

RTS	1	2	3	4	5
n	15	189	1,571	1,535	1,816
FTAI PR	0.0%	36.0%	48.0%	52.1%	59.4%

Thomas et al., 2012



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

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

From Bartol et al., 1995



### 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



### 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)



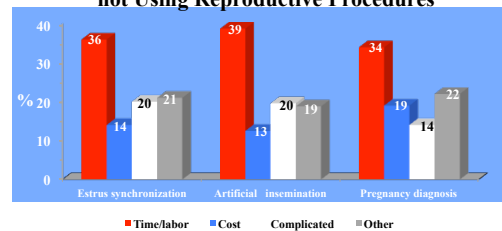
### Pregnancy rates of heifers in natural service versus synchronized and AI'd herds

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

<sup>1</sup>: NS=natural service; SAI=synchronized and AI'd  
<sup>a,b</sup>p<.05  
 Adapted from Randle and Patterson, 2005



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



From NAHMS Survey, 2008



# MGA-Based Protocols for Heifers

## MGA-PG

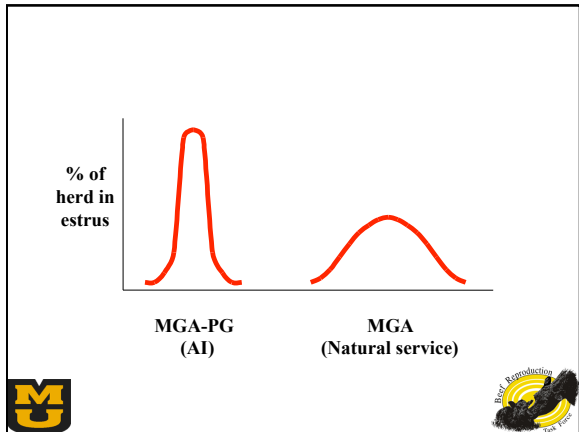
- MGA-PG was the preferred method of estrus synchronization in beef heifers (Brown et al., 1986; Deutscher et al., 2000; Lamb et al., 2000).

Treatment day

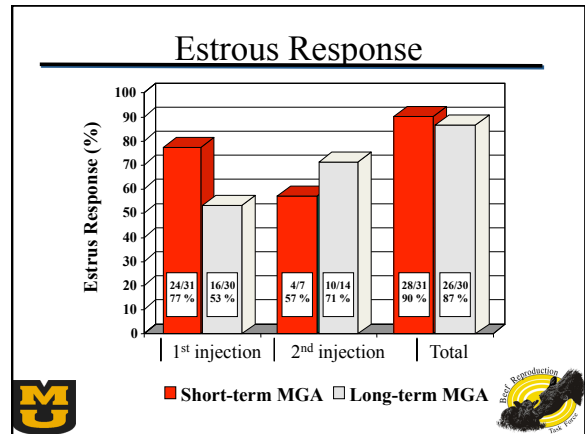
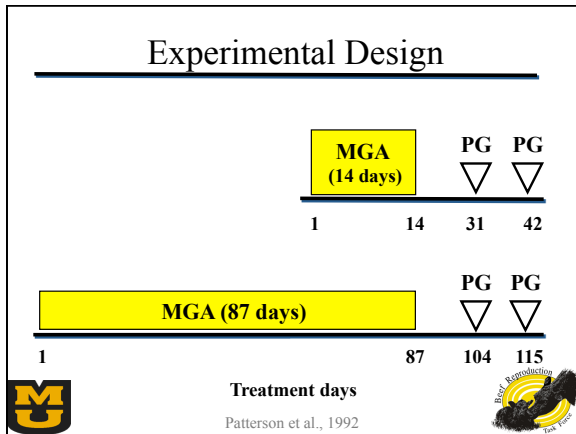
Treatment days

### MGA prior to Natural Service or MGA-PG prior to AI

Breeding program	No. heifers	Estrous response	Synchronized conception rate	Synchronized pregnancy rate
Natural service	1749	---	---	1151/1749 66%
AI	4245	3354/4245 79%	2414/3354 72%	2414/4245 57%



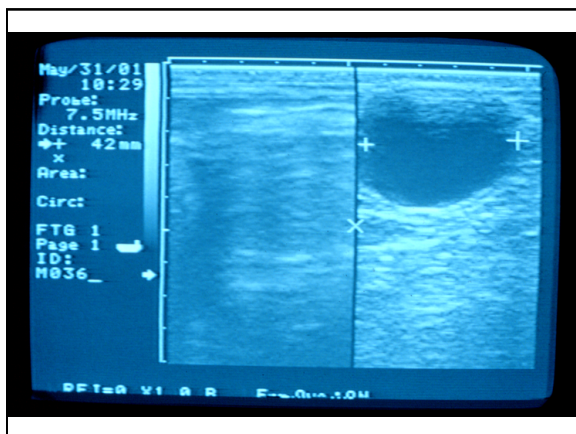
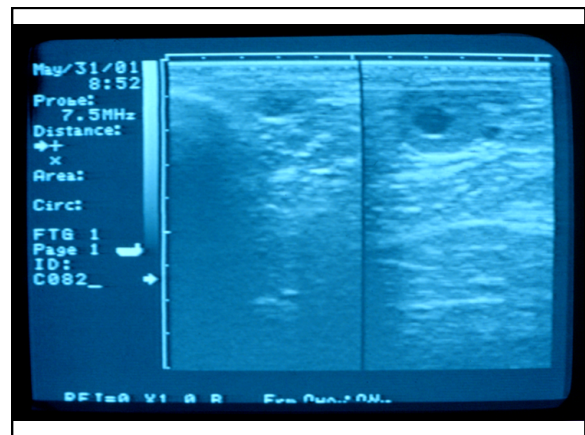
## Considerations pertaining to long-term MGA feeding

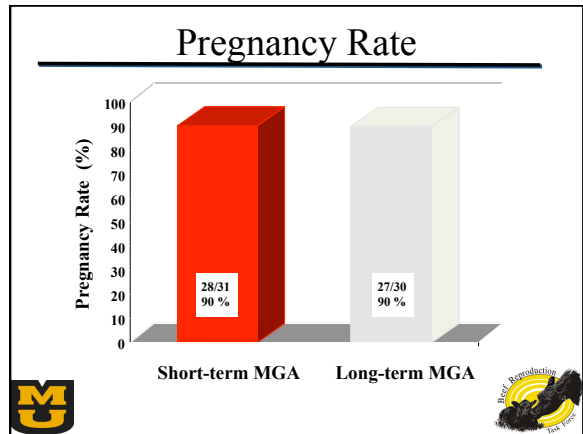
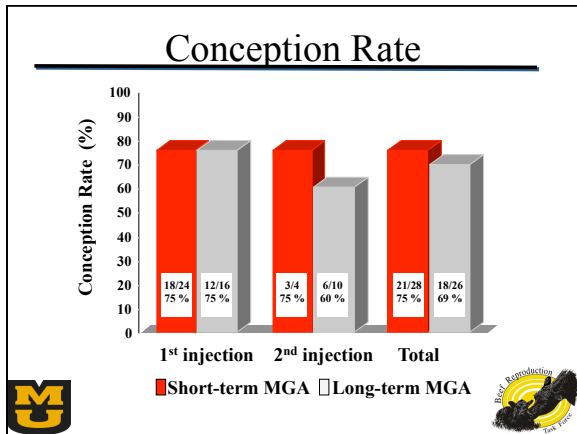


### Ovarian Morphology

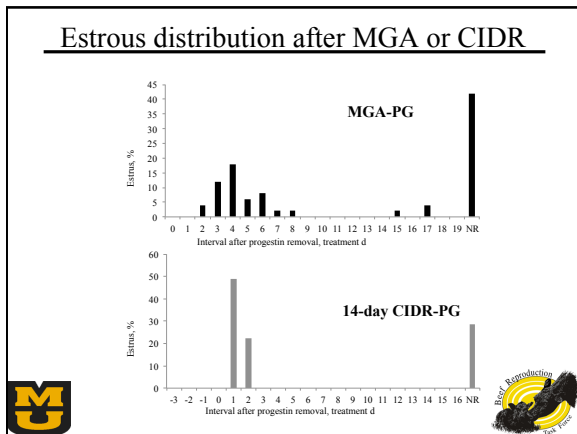
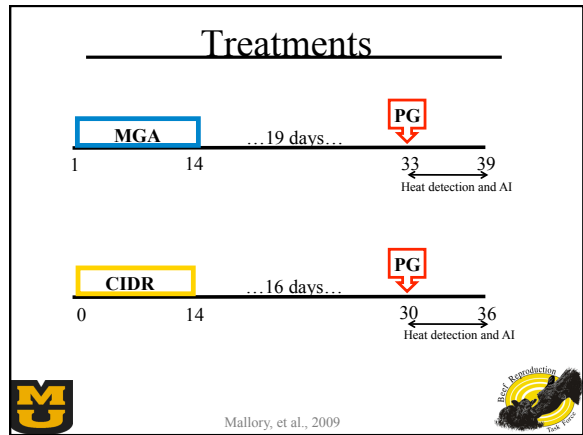
Treatment	Normal	Abnormal
Short-term MGA	31/31 100 %	0/31 0 %*
Long-term MGA	19/30 63 %	11/30 37 %*

Abnormal = Luteinized follicular cyst      \* P < 0.01





How do MGA- and CIDR-based protocols compare in heifers?



### 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 <sup>a</sup>	37.8 ± 11.2 <sup>b</sup>
Variance for interval to estrus	9172 <sup>a</sup>	136 <sup>b</sup>

<sup>a,b</sup> Means within rows with different superscripts differ ( $P < 0.01$ )

## Estrous response after PG

	Treatment	
	MGA-PG	14-day CIDR-PG
Overall estrous response	170/200 85 <sup>a</sup>	180/196 92 <sup>b</sup>
Estrous cycling	135/154 88 <sup>c</sup>	138/151 91
Prepubertal	35/46 76 <sup>c,y</sup>	42/45 93 <sup>d</sup>

<sup>a,b</sup> Means within rows with different superscripts differ ( $P = 0.01$ )

<sup>c,d</sup> Means within rows with different superscripts differ ( $P = 0.03$ )

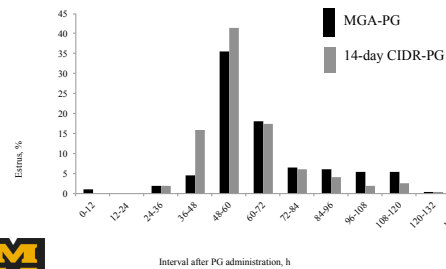
<sup>x,y</sup> Means within rows with different superscripts tend to differ ( $P = 0.06$ )



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 <sup>a</sup>	282 <sup>b</sup>

<sup>a,b</sup> Means within rows with different superscripts differ ( $P = 0.01$ )



Mallory, et al., 2009



## Conclusion

- Estrous response ( $P = 0.01$ ) and synchrony of estrus ( $P < 0.01$ ) were significantly improved among heifers assigned to the 14-day CIDR-PG protocol.
- Pre-synchronization with a 14-d CIDR followed 16 d later with PG provides an effective alternative for use in synchronizing estrus in replacement beef heifers.
- There were no differences between treatments for synchronized conception or pregnancy rates.

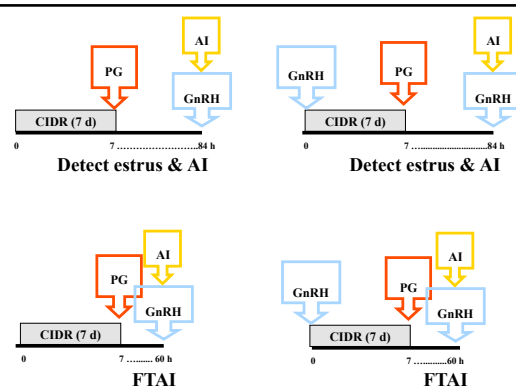


Mallory, et al., 2009

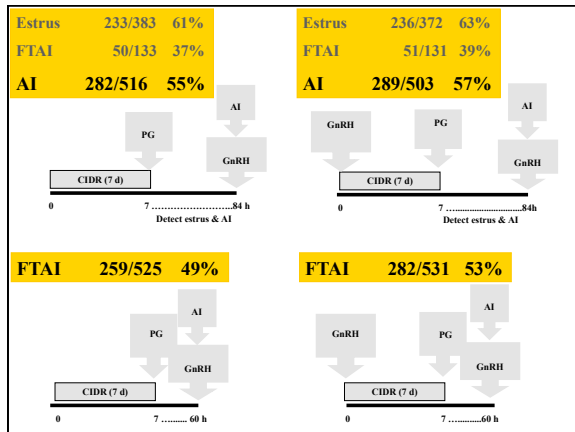


## The Multi-State CIDR Trial

Lamb et al., 2006



Lamb et al., 2006

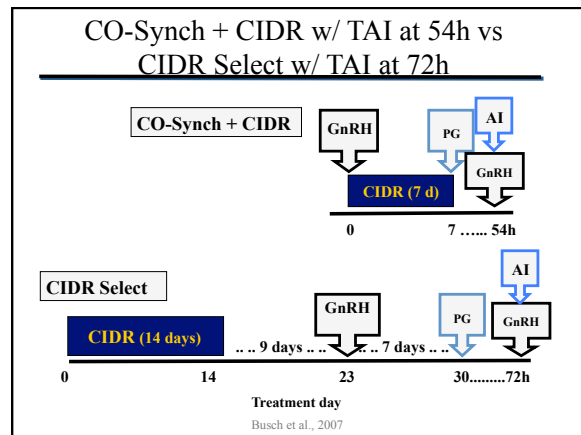


## Multi-state CIDR Trial

- 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

**How do long- and short-term CIDR-based protocols compare in heifers?**



### AI pregnancy

	Fixed-time AI pregnancy rate		
	Pre/periparturient	Estrous cycling	Combined
CIDR Select	13/21 (62%)	54/87 (62%) <sup>x</sup>	67/108 (62%) <sup>x</sup>
CO-Synch + CIDR	11/23 (48%)	40/86 (47%) <sup>y</sup>	51/109 (47%) <sup>y</sup>
<b>Total</b>	<b>24/44 (55%)</b>	<b>94/173 (54%)</b>	<b>118/217 (54%)</b>
Diff.	+ 14 %	+ 15 % <sup>x,y</sup> P= 0.03	+ 15 % <sup>x,y</sup> P= 0.02

Busch et al., 2007

### CIDR Select vs CO-Synch + CIDR

- Synchronizing beef heifers with the CIDR Select protocol resulted in:
  - Increased response to GnRH ( $P = 0.01$ )
  - Higher estrous response ( $P = 0.06$ )
  - Reduced variance associated with the interval from PG to estrus and ovulation ( $P < 0.01$ )
  - Significantly higher FTAI pregnancy rates ( $P = 0.02$ )
    - CIDR Select = 62%
    - CO-Synch + CIDR = 47%
  - Reduced variance associated with the interval from FTAI to the subsequent return to estrus ( $P < 0.05$ )

Busch et al., 2007; Leitman et al., 2008

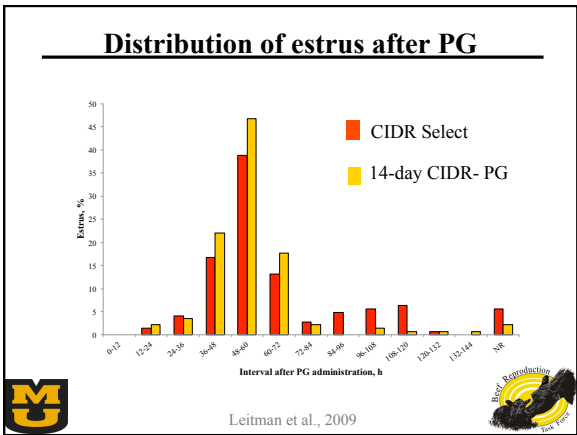
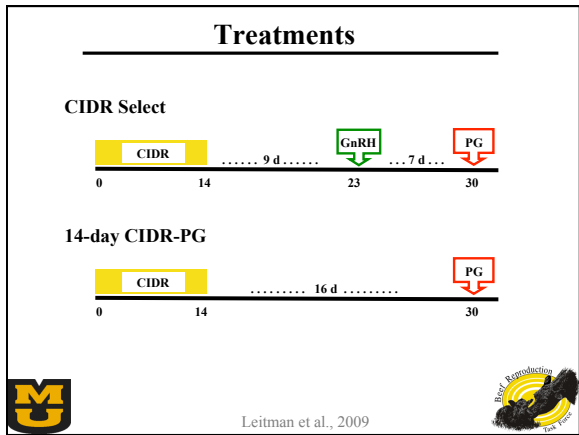


# How do the CIDR Select and 14-day CIDR-PG protocols compare?

## How do the CIDR Select and 14-day CIDR-PG protocols compare?

- Estrous response
- Interval to and synchrony of estrus
- Synchronized pregnancy rate

Leitman et al., 2009



### 14-day CIDR-PG vs. CIDR Select

- Estrous response was similar between treatments (98% , 14-day CIDR-PG; 94%, CIDR Select;  $P = 0.43$ )
- Mean interval to estrus was 7 h earlier ( $P = 0.01$ ) for 14-day CIDR-PG treated heifers compared to CIDR Select treated heifers
- Heifers assigned to 14-day CIDR-PG had a greater ( $P < 0.01$ ) synchrony of estrus compared to heifers assigned to CIDR Select

Leitman et al., 2009

### Pregnancy results

	Treatment	
	CIDR Select	14- day CIDR-PG
AI conception rate	78/135 (58) <sup>x</sup>	92/137 (67) <sup>y</sup>
AI pregnancy rate	78/143 (55) <sup>a</sup>	92/140 (66) <sup>b</sup>
Final pregnancy rate	116/143 (81)	113/140 (81)

<sup>x,y</sup> Means within rows with different superscripts tend to differ ( $P = 0.09$ )  
<sup>a,b</sup> Means within rows with different superscripts differ ( $P = 0.05$ )

Leitman et al., 2009

## Conclusion

- The administration of GnRH following CIDR removal in the CIDR Select protocol is not required to facilitate an improvement in the synchrony of estrus in beef heifers.

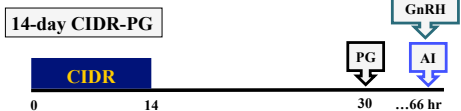
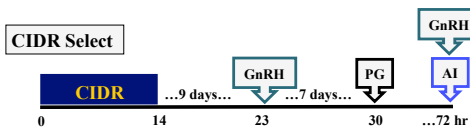


Leitman et al., 2009



How do the CIDR Select and 14-day CIDR-PG protocols compare on the basis of pregnancy rates resulting from fixed-time AI?

## Treatments

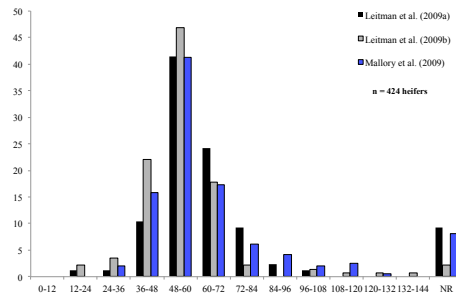


Mallory et al., 2011



## Combined Estrus Distribution

14-day CIDR-PG



## Fixed-time AI pregnancy rates

	Treatment	
	CIDR Select	14-day CIDR-PG
AI pregnancy rate	98/192 51 <sup>a</sup>	124/200 62 <sup>b</sup>
Estrous cycling	83/158 53 <sup>c</sup>	102/162 63 <sup>d</sup>
Prepubertal	15/34 44	22/38 58

<sup>a,b</sup> Means within rows with different superscripts tend to differ ( $P = 0.07$ )

<sup>c,d</sup> Means within rows with different superscripts tend to differ ( $P = 0.06$ )



Mallory et al., 2011



## Summary

- Pregnancy rates tended to be higher ( $P = 0.07$ ) for 14-day CIDR-PG compared to CIDR Select treated heifers.
- Final pregnancy rates did not differ between treatments.



Mallory et al., 2011



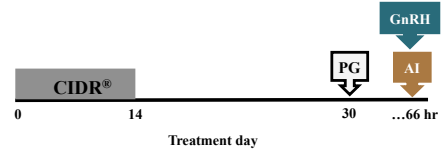
## Conclusion

- 14-day CIDR-PG is effective in synchronizing estrus prior to FTAI in beef heifers.

	Heat detection	Fixed-time AI
Leitman et al. (2009a,b)	241/422	---
Mallory et al. (2009a)	57%	---
Mallory et al. (2009b)	---	124/200 62%
Cooperating herds (KS, MO, MT)	---	1605/2456 65%
Totals	241/422 57%	1729/2656 65%



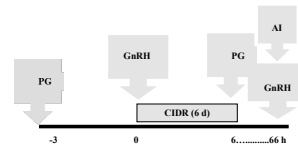
## 14-d CIDR-PG protocol for heifers



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



## PG 6-day CIDR



## Summary & Conclusions

### Comparison of estrous response and fertility in beef heifers after treatment with various estrus synchronization protocols.

Treatment	Estrous response	Synchronized pregnancy rate
<b>AI based on detected estrus</b>		
MGA-PG 14-19 d	1129/1302 87%	768/1302 59%
MGA* Select	433/499 87%	280/499 56%
CIDR-PG (d6)	200/285 70%	112/830 39%
CIDR Select	896/974 92%	577/974 59%
14-day CIDR-PG	394/422 93%	241/422 57%
<b>Heat detect &amp; fixed-time AI</b>		
7-day CIDR-PG: 84 hr		282/517 55%
Select Synch + CIDR: 84 hr		289/504 57%
14 d CIDR-PG: 72 hr		48/77 62%
14 d MGA + PG: 72hr		52/79 66%
<b>AI performed at predetermined fixed times with no estrus detection</b>		
7-day CIDR-PG	Fixed-time AI @ 60 hr	258/525 49%
CO-Synch + CIDR	Fixed-time AI @ 60 hr	282/531 53%
CO-Synch + CIDR	Fixed-time AI @ 54 hr	51/109 47%
CIDR Select	Fixed-time AI @ 72 hr	616/1051 58%
14-day CIDR-PG	Fixed-time AI @ 66 hr	1729/2656 65%

## Take Home Points

- Long-term CIDR-based protocols enhance synchrony of estrus in estrous cycling and pre- or peripubertal heifers compared to short-term CIDR-based or MGA-based protocols.
- Pregnancy rates resulting from fixed-time AI in beef heifers are expected to be higher following treatment with long-term CIDR-based protocols because of improvements in synchrony of estrus following treatment.



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