Synchronization Response: *Bos taurus* vs. *Bos indicus* Cattle

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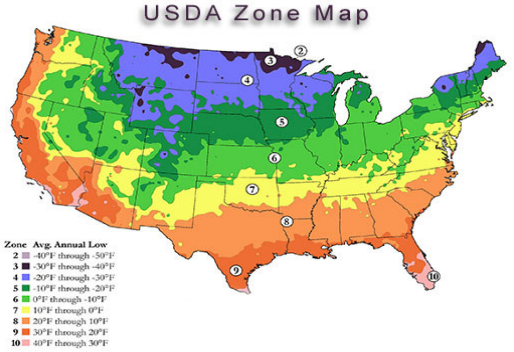
USDA Zone Map



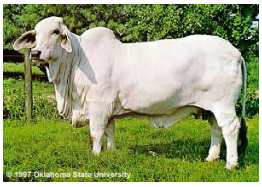
Bos taurus beef cattle

- Maternal and(or) terminal breeds
- Positive carcass traits: marbling,tenderness, yield
- Excellent production in temperate climates

Bos indicus Based Cattle "Positive Attributes"

- Heat tolerant
- Increased parasite & disease tolerance
- Improved production in subtropical climates

Bos indicus Based Cattle "Negative Attributes"



- Older age at puberty
- Decreased carcass quality & tenderness
- Potential handling stress issues
  - Management driven

Reproductive challenges with *Bos indicus* cattle

- Differences in concentrations and (or) sensitivities to GnRH, LH, estrogen, and progesterone
- Increased incidence of estrous cycles with three and four follicle waves
- Difficult to detect estrus, due to shorter estrous duration, decreased estrous intensity, and increased incidence of silent heats
- Postpartum period is extended
- More susceptible to (-) effects of handling stress

Synchronization Systems
Producer Perspective

- Cost effective
- Ease of implementation
- Minimal cattle handlings
- Yield consistent & acceptable pregnancy rates
- Fit into producers operation
  - Meet their goals and objectives
  - Physical & labor resources

MANIPULATING THE ESTROUS CYCLE

Regulation of CL regression	Synchronization of follicular growth & inducing ovulation for timed-AI	Prevent expression of estrus and induce estrous cycles
↓	↓	↓
Prostaglandin $F_{2\alpha}$ (PG)	GnRH	Progestogens (MGA) (CIDR)

Table 1. Commonly used hormones in estrous synchronization and their trade names[a].

Hormone (Abbreviation)	Commercial Products[b]
Gonadotropin Hormone Releasing Hormone (GnRH)	Cystorelin®, Factrel®, Fertagyl®, OvaCyst®
Progestins	
Progesterone	CIDR®, Intravaginal progesterone-releasing insert
Synthetic progestin	Melengestrol acetate (MGA®), Orally-active feed additive
Prostaglandin $F_{2\alpha}$ (PGF)	Lutalyse®, Estrumate®, ProstaMate®, estroPLAN™, In-Synch™

[a] Table adapted from M.L. Day and D.E. Grum, The Ohio State University

Estrous Synchronization Terminology

- **Estrous Response**

  Percentage of females that exhibited estrus during synchronized period
- **Conception Rate**

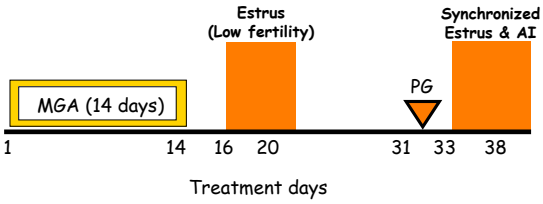
  Percent of heifers that conceived to AI of those that exhibited estrus
- **Timed-AI Pregnancy Rate**

  Percentage of females that became pregnant following a timed-AI
- **AI or Synchronized Pregnancy Rate**

  Percentage of females that became pregnant to AI of total treated

Beef Heifer Synchronization

MGA + PG



Brown et al., 1988

Yearling *Bos taurus* beef heifers synchronized with MGA + PG

TRT	#	Estrous Rate (%)	Conception Rate (%)	AI Pregnancy Rate (%)
Brown et al., 1988	157	83.0	69.0	57.0
Patterson, 1990	323	83.0	74.0	61.0

MGA® - PG

For TAI, perform TAI 72 ± 2 h after PG with GnRH at TAI
For heat detection and AI, forgo TAI and detect heat and AI until day 39

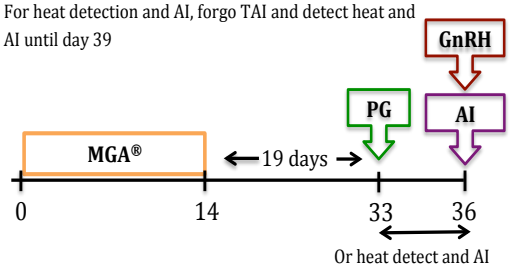
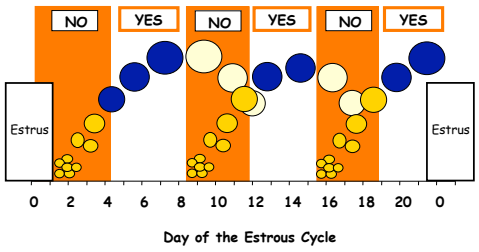


Table 3. Reproductive performance of yearling *Bos taurus* (Lamb) and yearling heifers of *Bos indicus* (Bridges) breeding synchronized with MGA-PG

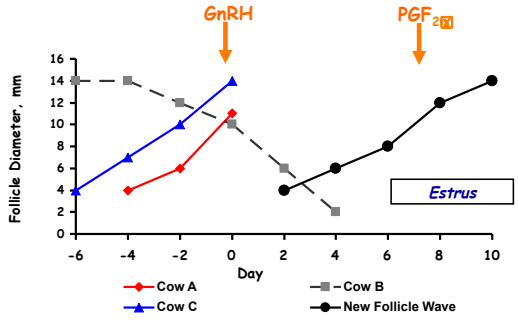
Treatment	n	Estrous response, %	Conception rate, %	Timed-AI pregnancy rate, %	Synchronized pregnancy rate, %
Lamb et al., 2000					
17 days	249	68.3	75.9	-	51.8
19 days	260	68.1	75.9	-	55.4
Bridges et al., 2005					
Single PGF	354	43.2[a]	48.8	23.9[a]	34.5[a]
Split PGF	341	50.1[b]	51.5	33.5[b]	42.5[b]

[a, b] ($P < 0.05$)

Effectiveness of GnRH to induce ovulation for follicle synchronization

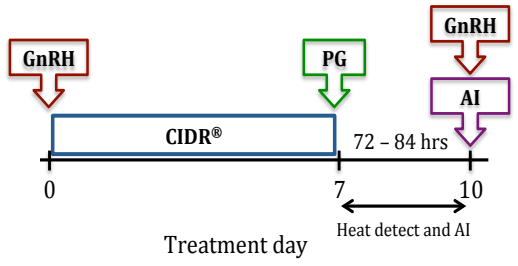


Effect of GnRH on Follicular Waves



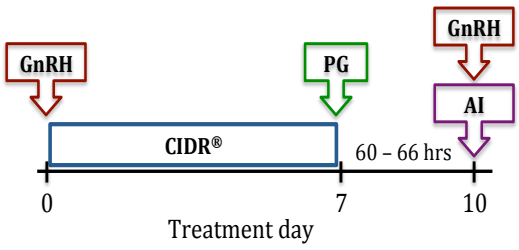
Select Synch + CIDR® and TAI

Heat detect and AI day 7 to 10 and TAI all non-responders 72-84 hours after PG with GnRH at TAI



7-Day CO-Synch + CIDR®

Perform TAI 60 to 66 h after PG with GnRH at TAI



5-Day CO-Synch + CIDR®

Perform TAI 72 ± 2 h after the first PG with GnRH at TAI
Two injections of PG (8 ± 2 hrs) are required for this protocol

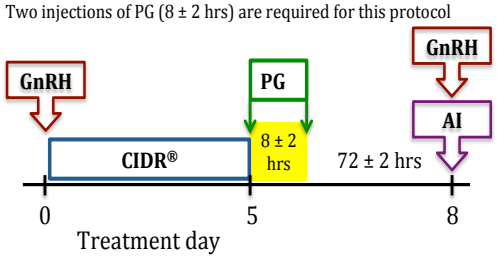


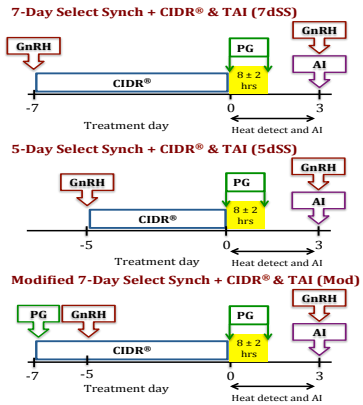
Table 4. Comparison of AI pregnancy rates between the 7-Day and 5-Day approaches to estrous synchronization in *Bos taurus* beef heifers.

		AI pregnancy rate		
	Reference	7-Day	5-Day	*P* - value
CO-Synch + CIDR	Wilson et al., 2007	49.0% (n = 204)	59.7% (n = 201)	< 0.05
Select Synch + CIDR and TAI	Sparks et al., 2010	47.3% (n = 298)	57.1% (n = 367)	< 0.05

Select Synch + CIDR and TAI in 2 yr old Angus, Brahman, and respective crosses

	Percentage Brahman (n)					
Variable	AN	1/4	3/8	1/2	3/4	BR
Estrous Response, %	55.6[a] (27)	27.6[b,c] (29)	38.9[a,c] (18)	55.6[a,d] (45)	40.0[a, b] (20)	66.7[d] (24)
Conception Rate, %	53.3 (15)	62.5 (8)	71.5 (7)	56.0 (25)	50.0 (8)	75.0 (16)
Timed-AI Pregnancy Rate, %	58.3 (12)	37.9 (29)	33.3 (18)	46.7 (45)	35.0 (20)	58.3 (24)
Synchronized Pregnancy Rate, %	55.6 (27)	37.9 (29)	33.3 (18)	46.7 (45)	35.0 (20)	58.3 (24)

[a,b,c,d] (P < 0.05); J.V. Yelich, unpublished data



Working Hypothesis

- Reducing progesterone concentrations during development of the follicular wave would:
  - ↓ Progesterone causes an ↑ LH (Roberson et al., 1989; Dias et al., 2009)
  - Increase dominant follicle growth and diameter (Carvalho et al., 2008)
  - Increase pre-ovulatory estradiol production (Sirois and Fortune, 1990)
  - Enhance oocyte viability (Revah and Butler, 1996)
  - Enhance subsequent luteal function (Butler et al., 1996)
  - Increase estrous response and conception rates to AI and timed-AI

Courtesy Brandy Sparks, Purdue

Table 5. Reproductive performance of yearling beef heifers of *Bos taurus* breeding

TRT	n	Estrous Response, %	Conception Rate, %	Timed-AI Conception Rate, %	AI Pregnancy Rate, %
5dSS	367	56.1[a]	62.0[c]	50.9	57.1[a]
7dSS	298	67.1[b]	50.0[d]	41.8	47.3[b]
Mod	374	69.3[b]	65.6[c]	42.1	58.4[a]

[a,b] $P < 0.05$
[c,d] $P < 0.01$

Sparks et al., 2010

Table 6. Reproductive performance of yearling beef heifers of *Bos indicus* breeding

Treatments	N	Estrous Response, %	Conception Rate, %	Timed-AI pregnancy rate, %	AI pregnancy rate, %
5dSS	113	21.2[a]	33.3[a]	15.7	19.5[a]
7dSS	113	34.5[b]	38.5[a]	14.9	23.0[a]
Mod	117	42.7[b]	62.0[b]	19.4	37.6[b]

[a,b] ($P < 0.05$).

Bischoff et al., 2011

Table 7. Reproductive tract score (RTS) effects on reproductive performance of yearling beef heifers of *Bos indicus* breeding

RTS	N	Estrous Response, %	Conception Rate, %	Timed-AI pregnancy rate, %	Synchronized pregnancy rate, %	Thirty-day pregnancy rate, %
1	51	13.7[a]	14.3	9.1	9.8[a]	31.4[a]
2	74	10.8 [a]	50.0	12.1	16.2[a]	44.6[a]
3	76	39.5[b]	50.0	23.9	34.2[b]	59.2[b]
4	98	49.0[b]	54.2	18.0	35.7[b]	68.4[b]
5	44	45.5[b]	40.0	25.0	31.8[b]	72.7[b]
P-value		P < 0.05	P > 0.05	P > 0.05	P < 0.05	P < 0.05

Bischoff et al., 2011

Bos taurus beef heifer Synchronization

- MGA + PG and TAI
- 5 Day Co-Synch + CIDR
- 7 Day Select Synch + CIDR and TAI
- Response dependent on pubertal status

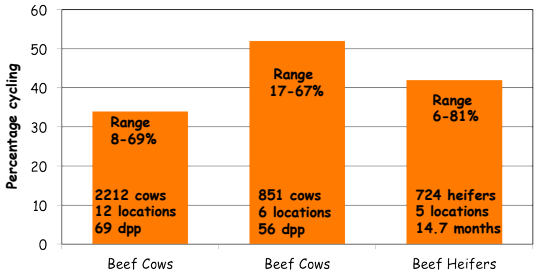
Bos indicus beef heifer synchronization

- Response dependent on pubertal status
- MGA + PG (Split) and TAI
- 7 Day Select Synch + CIDR and TAI (Variable Results)
- 5 Day Co-Synch + CIDR (NO!!!! NO!!!!!)
- Modified 7 Day Select Synch + CIDR and TAI
  - Potential system but increased cattle handling

Beef Cow Synchronization

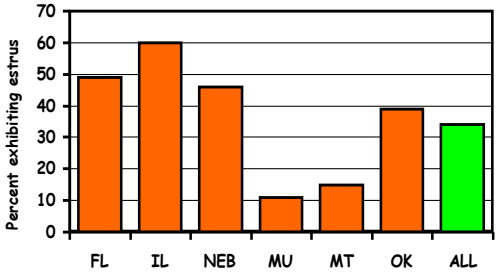
- Suckling calf
- Decreased percentage of estrous cycling cows at breeding
- Synchronization response
  - Dependent on nutritional status pre-calving

Anestrus in US beef cattle at start of synchronization



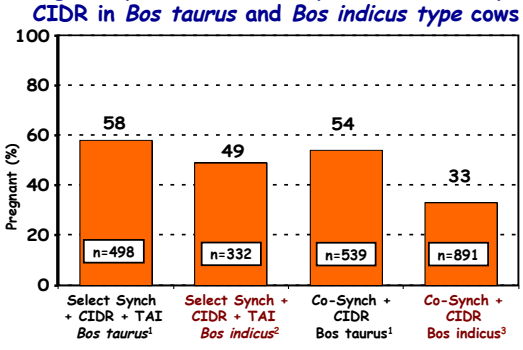
Lucy et al., 2001; Larson et al., 2006

Effectiveness of the CIDR to induce estrus in lactating anestrous (non-cycling) cows



Lucy et al., 2001

Fig 3. Synchronization responses with 7 day CIDR in *Bos taurus* and *Bos indicus type* cows



(Larsen et al., 2006[1]; Saldarriaga et al., 2004[3]; Yelich, 2000[3], Esterman, 2011[2])

Table 4. Comparison of AI pregnancy rates between the 7-Day and 5-Day approaches to estrous synchronization in *Bos taurus* beef cows.

		AI pregnancy rate		
	Reference	7-Day	5-Day	*P* - value
CO-Synch + CIDR	Bridges et al., 2008, Year 1	66.7% (n = 111)	80.0% (n = 105)	< 0.05
	Bridges et al., 2008, Year 2	56.2% (n = 201)	65.3% (n = 199)	< 0.05

Select Synch + CIDR and TAI in suckled *Bos indicus type* cows

Item	Year 1	Year 2	Year 3	Combined
Estrous response,%	47.6 (63)	45.2 (62)	52.9 (157)	48.5 (282)
Conception rate, %	68.8 (30)	60.7 (28)	77.1 (83)	68.8 (141)
Timed AI pregnancy rate, %	30.3 (33)	58.8 (34)	46.0 (74)	44.8 (141)
Synchronized pregnancy rate, %	50.8 (63)	59.7 (62)	62.4 (157)	57.6 (282)

Esterman et al., 2008: (Mean: BCS 5.0, DPP 75 days)

Select Synch + CIDR and TAI in Suckled Angus, Brahman, and respective crosses

	Percentage Brahman (n)					
Variable	AN	1/4	3/8	1/2	3/4	BR
Estrous Response, %	62.9[a] (70)	44.3[b] (70)	68.6[a] (35)	45.4[b] (97)	37.5[b] (32)	45.2[b] (31)
Conception Rate, %	68.2 (44)	54.8 (31)	50.0 (24)	72.7 (44)	50.0 (12)	57.1 (14)
Timed-AI Pregnancy Rate, %	38.5 (26)	48.7 (39)	36.4 (11)	45.3 (53)	35.0 (20)	23.5 (17)
AI Pregnancy Rate, %	57.1 (70)	51.4 (70)	45.7 (35)	57.7 (97)	40.6 (32)	38.7 (31)

[a,b] (P < 0.05); J.V. Yelich, unpublished data

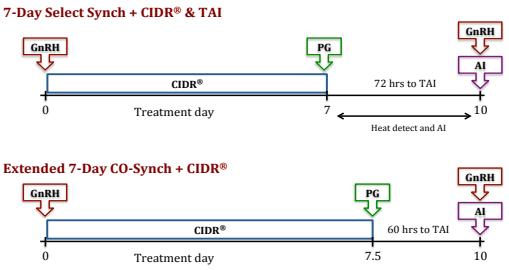
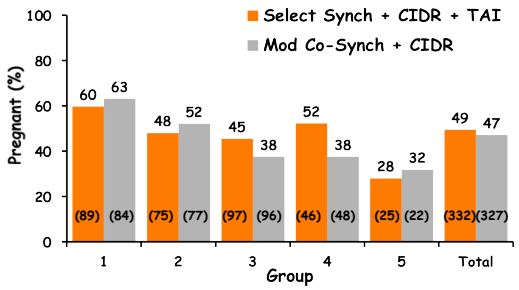


Figure 4. Description of the 7-Day Select Synch + CIDR and TAI and the Extended 7-Day CO-Synch + CIDR treatments used to synchronize suckled *Bos indicus* x *Bos taurus* beef cows. Blood samples were collected at and 10 days prior to CIDR insertion to determine estrous cycling status of cows (Esterman, 2011)

AI pregnancy rates in *Bos indicus* type cows



Trt (P > 0.05), Group (P < 0.05), Trt × Group (P > 0.05); Esterman 2011

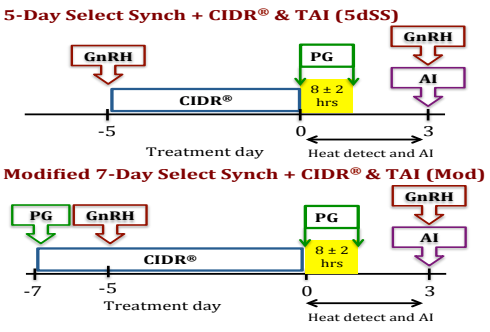
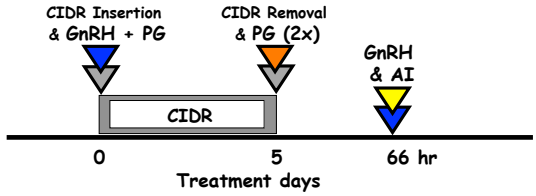


Table 8. Reproductive performance of suckled Angus and Brangus cows

Breed x Treatment		n	Estrous response, %	Conception rate, %	Timed-AI pregnancy rate, %	Synchronized pregnancy rate, %
Angus	5dSS	87	71.2	67.7	40.0	59.8
	Mod	90	70.0	71.4	51.9	65.6
Brangus	5dSS	74	51.4	57.9	33.3	41.9
	Mod	74	75.7	60.7	26.1	54.1

J. V. Yelich, unpublished data

Modified 5-Day Co-Synch + CIDR "Bee Synch" Gary Williams, TAMU



- Suckled *Bos indicus* type cows: > 45 DPP ≥ 5.0 BCS
- AI Pregnancy Rates: 52-58%

Bos taurus Beef Cow Synchronization

- 5 Day Co-Synch + CIDR
- 7 Day Select Synch + CIDR and TAI
- Response dependent:
  - BCS, DPP, and cycling status

Bos indicus type Beef Cow Synchronization

- 7 Day Select Synch + CIDR and TAI
  - Variable response
  - Dependent on herd management
- 5 & 7 Day Co-Synch + CIDR: NO!!!! No!!!!
- Potential Systems
  - Modified 7 Day Select-Synch + CIDR and TAI
  - Bee Synch
  - Disadvantage: increased cattle handling

Summary

- Synchronization systems in *Bos taurus* do not yield consistently similar results in *Bos indicus* type cattle
  - Reasons unclear: endocrine responses/follicle dynamics
- Recently designed systems for *Bos indicus* show promise
  - Disadvantage: additional cattle handling

Summary

- AI Synchronization success dependent on:
  - Cycling status in heifers/cows
  - BCS and DPP in cows
  - Maintaining system & procedure compliance
- Cost vs. Benefit

FLIGHT Zone