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

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Beef Improvement Federation
Houston, Texas

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*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

USDA Zone Map
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_2α (PG)
GnRH
Progestogens (MGA) (CIDR)

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

<table>
<thead>
<tr>
<th>Hormone (Abbreviation)</th>
<th>Commercial Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonadotropin Hormone Releasing Hormone (GnRH)</td>
<td>Cystorelin, Factrel, Fertagyl, OvaCyst</td>
</tr>
</tbody>
</table>
| Progestins | CIDR, Intravaginal progesterone-releasing insert
| Progesterone | Melengestrol acetate (MGA), Orally-active feed additive
| Synthetic progestin | Lutalyse, Estrumate, ProstaMate, estronPLAN™, In-Synch™ |

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

Estrus (Low fertility)
Synchronized Estrus & AI

MGA (14 days)
PG

1 14 16 20 31 33 38
Treatment days

Brown et al., 1988
Yearling *Bos taurus* beef heifers synchronized with MGA + PG

<table>
<thead>
<tr>
<th>TRT</th>
<th>Estrous Rate (%)</th>
<th>Conception Rate (%)</th>
<th>AI Pregnancy Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown et al., 1988</td>
<td>157</td>
<td>83.0</td>
<td>69.0</td>
</tr>
</tbody>
</table>
| 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

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Estrous response, n</th>
<th>Conception rate, %</th>
<th>Timed-AI pregnancy rate, %</th>
<th>Synchronized pregnancy rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamb et al., 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 days</td>
<td>249</td>
<td>68.3</td>
<td>75.9</td>
<td>51.8</td>
</tr>
<tr>
<td>19 days</td>
<td>260</td>
<td>68.1</td>
<td>75.9</td>
<td>55.4</td>
</tr>
<tr>
<td>Bridges et al., 2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single PGF</td>
<td>354</td>
<td>43.2*</td>
<td>48.8</td>
<td>23.9*</td>
</tr>
<tr>
<td>Split PGF</td>
<td>341</td>
<td>50.1*</td>
<td>51.5</td>
<td>33.5*</td>
</tr>
</tbody>
</table>

*P < 0.05

Effectiveness of GnRH to induce ovulation for follicle synchronization

Day of the Estrous Cycle

Effect of GnRH on Follicular Waves

![Effect of GnRH on Follicular Waves](image_url)
**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

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

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>AN</th>
<th>1/4</th>
<th>3/8</th>
<th>1/2</th>
<th>3/4</th>
<th>BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrous Response, %</td>
<td>55.6</td>
<td>27.6</td>
<td>38.9</td>
<td>55.6</td>
<td>40.0</td>
<td>66.7</td>
</tr>
<tr>
<td>(27)</td>
<td>(29)</td>
<td>(18)</td>
<td>(45)</td>
<td>(20)</td>
<td>(24)</td>
<td></td>
</tr>
<tr>
<td>Conception Rate, %</td>
<td>53.3</td>
<td>62.5</td>
<td>71.5</td>
<td>56.0</td>
<td>50.0</td>
<td>75.0</td>
</tr>
<tr>
<td>(15)</td>
<td>(8)</td>
<td>(7)</td>
<td>(25)</td>
<td>(8)</td>
<td>(16)</td>
<td></td>
</tr>
<tr>
<td>Timed-AI Pregnancy Rate, %</td>
<td>58.3</td>
<td>37.9</td>
<td>33.3</td>
<td>46.7</td>
<td>35.0</td>
<td>58.3</td>
</tr>
<tr>
<td>(12)</td>
<td>(29)</td>
<td>(18)</td>
<td>(45)</td>
<td>(20)</td>
<td>(24)</td>
<td></td>
</tr>
<tr>
<td>Synchronized Pregnancy Rate, %</td>
<td>55.6</td>
<td>37.9</td>
<td>33.3</td>
<td>46.7</td>
<td>35.0</td>
<td>58.3</td>
</tr>
<tr>
<td>(27)</td>
<td>(29)</td>
<td>(18)</td>
<td>(45)</td>
<td>(20)</td>
<td>(24)</td>
<td></td>
</tr>
</tbody>
</table>

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

**7-Day CO-Synch + CIDR®**

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

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

<table>
<thead>
<tr>
<th>Reference</th>
<th>AI pregnancy rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7-Day preg rate</td>
</tr>
<tr>
<td>CO-Synch + CIDR</td>
<td>40.0% ± 66.7%</td>
</tr>
<tr>
<td>(n = 204)</td>
<td>(n = 201)</td>
</tr>
<tr>
<td>Select Synch +</td>
<td>47.3% ± 58.3%</td>
</tr>
<tr>
<td>Sparks et al,</td>
<td>(n = 298)</td>
</tr>
<tr>
<td>2010</td>
<td></td>
</tr>
</tbody>
</table>

**7-Day Select Synch + CIDR® & TAI (7dSS)**

**5-Day Select Synch + CIDR® & TAI (5dSS)**

**Modified 7-Day Select Synch + CIDR® & TAI (Mod)**
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

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

<table>
<thead>
<tr>
<th>TRT</th>
<th>Estrous Response, %</th>
<th>Conception Rate, %</th>
<th>Timed-AI Conception Rate, %</th>
<th>AI Pregnancy Rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5dSS</td>
<td>367</td>
<td>56.1a</td>
<td>62.0c</td>
<td>50.9</td>
</tr>
<tr>
<td>7dSS</td>
<td>298</td>
<td>67.1b</td>
<td>50.0d</td>
<td>41.8</td>
</tr>
<tr>
<td>Mod</td>
<td>374</td>
<td>69.3c</td>
<td>65.6c</td>
<td>42.1</td>
</tr>
</tbody>
</table>

a,b p < 0.05

Sparks et al., 2010

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

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N</th>
<th>Estrous Response, %</th>
<th>Conception Rate, %</th>
<th>Timed-AI pregnancy rate, %</th>
<th>AI pregnancy rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5dSS</td>
<td>113</td>
<td>21.2</td>
<td>33.3</td>
<td>15.7</td>
<td>19.5</td>
</tr>
<tr>
<td>7dSS</td>
<td>113</td>
<td>34.5</td>
<td>38.5</td>
<td>14.9</td>
<td>23.0</td>
</tr>
<tr>
<td>Mod</td>
<td>117</td>
<td>42.7</td>
<td>62.0</td>
<td>19.4</td>
<td>37.6</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>RTS</th>
<th>N</th>
<th>Estrous Response, %</th>
<th>Conception Rate, %</th>
<th>Timed-AI pregnancy rate, %</th>
<th>Synchronized pregnancy rate, %</th>
<th>Thirty-day pregnancy rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51</td>
<td>13.7</td>
<td>14.3</td>
<td>9.1</td>
<td>9.8</td>
<td>31.4</td>
</tr>
<tr>
<td>2</td>
<td>74</td>
<td>10.8</td>
<td>15.0</td>
<td>12.1</td>
<td>16.2</td>
<td>44.6</td>
</tr>
<tr>
<td>3</td>
<td>76</td>
<td>39.5</td>
<td>50.0</td>
<td>23.9</td>
<td>34.3</td>
<td>59.2</td>
</tr>
<tr>
<td>4</td>
<td>98</td>
<td>49.0</td>
<td>54.2</td>
<td>18.0</td>
<td>35.7</td>
<td>68.4</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>45.9</td>
<td>40.0</td>
<td>25.0</td>
<td>31.8</td>
<td>72.3</td>
</tr>
</tbody>
</table>

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 + P6 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 + P6 (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**

- Range 8-69%
- Range 17-67%
- Range 6-81%
- 2212 cows: 12 locations, 69 dpp
- 851 cows: 6 locations, 56 dpp
- 724 heifers: 5 locations, 14.7 months

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

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

*Lucy et al., 2001*

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

<table>
<thead>
<tr>
<th></th>
<th>Select Synch</th>
<th>Select Synch + TAI</th>
<th>Co-Synch + CIDR</th>
<th>Co-Synch + CIDR + TAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef taurus</td>
<td>58</td>
<td>49</td>
<td>54</td>
<td>33</td>
</tr>
<tr>
<td>n=498</td>
<td>n=322</td>
<td>n=539</td>
<td>n=891</td>
<td></td>
</tr>
</tbody>
</table>

*(Larsen et al., 2006; Saldarriaga et al., 2004; Yelich, 2000; Esterman, 2011)*

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

<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
<th>7-Day</th>
<th>5-Day</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD-Synch + CIDR</td>
<td>Bridges et al., 2008, Year 1</td>
<td>66.7%</td>
<td>80.0%</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>(n = 111)</td>
<td>(n = 105)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridges et al., 2008, Year 2</td>
<td>56.2%</td>
<td>65.3%</td>
<td></td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>(n = 201)</td>
<td>(n = 199)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Select Synch + CIDR and TAI in suckled 
*Bos indicus* type cows

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

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

---

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy rate, %</td>
<td>68.8 (30)</td>
</tr>
<tr>
<td>Conception rate, %</td>
<td>68.2 (44)</td>
</tr>
<tr>
<td>Timed-AI Pregnancy Rate, %</td>
<td>38.5 (26)</td>
</tr>
<tr>
<td>AI Pregnancy Rate, %</td>
<td>57.1 (70)</td>
</tr>
</tbody>
</table>

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5-Day Select Synch + CIDR® & TAI (5dSS)

- Treatment day 0: GoBiH
- Treatment day 0: PG
- Treatment day 0: AI

Modified 7-Day Select Synch + CIDR® & TAI (Mod)

- Treatment day -5: GoBiH
- Treatment day 0: PG
- Treatment day 0: AI

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Table 8. Reproductive performance of suckled Angus and Brangus cows

<table>
<thead>
<tr>
<th>Breed x Treatment</th>
<th>Estrous response, %</th>
<th>Conception rate, %</th>
<th>Timed-AI pregnancy rate, %</th>
<th>Synchronized pregnancy rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus 5dSS</td>
<td>71.2</td>
<td>67.7</td>
<td>40.0</td>
<td>59.8</td>
</tr>
<tr>
<td>Mod</td>
<td>70.0</td>
<td>71.4</td>
<td>51.9</td>
<td>65.6</td>
</tr>
<tr>
<td>Brangus 5dSS</td>
<td>51.4</td>
<td>57.9</td>
<td>33.3</td>
<td>41.9</td>
</tr>
<tr>
<td>Mod</td>
<td>75.7</td>
<td>60.7</td>
<td>26.1</td>
<td>54.1</td>
</tr>
</tbody>
</table>

J. V. Yelich, unpublished data
Modified 5-Day Co-Syn + CIDR  
"Bee Synch"  
Gary Williams, TAMU

<table>
<thead>
<tr>
<th>CIDR Insertion &amp; GnRH + PG</th>
<th>CIDR Removal &amp; PG (2x)</th>
<th>GnRH &amp; AI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>66 hr</td>
</tr>
</tbody>
</table>

- 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