Improving Reproductive Performance in Lactating Dairy Cows

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Yinchuan - China
Objectives of Reproductive Program for Dairy Cows

**Ultimate Goal:** impregnate cows quickly after the VWP

- **↑ Pregnancy Rate**
- **↑ Insemination Rate**
- **↑ Insemination Rate**
- **↓ Pregnancy Loss**

Timeline:
- **VWP**
- **1st AI**
- **2nd AI**
- **Conception**
- **Gestation**
- **↑ P/AI**
- **↑ P/AI**
- **↑ P/AI**

**Calving**

**↓ Insemination**
Strategies to Breed Lactating Dairy Cows Past the VWP
Breeding Dairy Cows Past the VWP – Natural Service

Economic advantage of timed over natural service → US$ 5.69 to 232.76

✓ Increases with increasing feed costs
✓ Natural service is advantageous only if semen is expensive (US$ 22.00/straw)

Other advantages of AI

✓ Decrease risk for disease transmission
✓ Enhance genetic gain
✓ Reduce risk of accidents

NS = 25.7%
TAI = 25.0%
1 TAI = 19.6%
3 TAI = 23.1%

Lima et al. (2012) Theriogenology 77:1918-1927
Breeding Dairy Cows Past the VWP – Estrus Detection

➢ Detection of estrus is suboptimal in most dairy herds

US average estrus detection = 46%

Heat stress
Lameness
Anovulation

Intensity of estrus
High milk yield associated with shorter estrus and fewer mounts per estrus

Personnel and facilities
Muddy/slippery floors
**Breeding Dairy Cows Past the VWP – Timed AI**

<table>
<thead>
<tr>
<th>Herd 1</th>
<th>Herd 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrus detection</td>
<td>Timed AI</td>
</tr>
<tr>
<td>Cows, no.</td>
<td>198</td>
</tr>
<tr>
<td>DIM at 1(^{st}) AI</td>
<td>97.0(^b)</td>
</tr>
<tr>
<td>21-d EDR, %</td>
<td>55.6(^b)</td>
</tr>
<tr>
<td>Overall P/AI, %</td>
<td>45.4</td>
</tr>
<tr>
<td>21-d PR, %</td>
<td>25.2</td>
</tr>
</tbody>
</table>

DIM = Days in milk  
EDR = Estrus detection rate  
P/AI = Pregnancy per AI  
PR = Pregnancy rate

Timed AI Protocols for Dairy Cows

- Resynch
- Show-me-synch
- DOUBLE-OVSYNCH
- Ultrasynch
- Heatsynch
- OvSynch-56
- OvSynch-48
- Cosynch-48
- 5-d Timed AI
- COSYNCH-72
- 7-11 Synch
- GGPPG-GPPG
- PRESYNCH
- MGA-Select
- BeeSynch
- 2CIDR
- G6G
- GGPG
- GPG
Timed AI Protocols for Lactating Dairy Cows

4 key points of timed AI protocols:

- **Ovulation and Follicular emergence**
- **Luteolysis**
- **Synchronized ovulation**

**Diagram:**
- **GnRH** (buserelin, gonadorelin)
- **PGF$_{2\alpha}$** (dinoprost, cloprostenol)
- **Progesterone**
- **AI**
Improving Response to Initial GnRH

- **d 5 to 9**
  - Ovulation = 96%
- **d 10 to 16**
  - Ovulation = 54%
- **d 17 to 21**
  - Ovulation = 77%

- **d 1 to 4**
  - Ovulation = 23%

Deviation noted in the cycle phases.

Improving Response to Initial GnRH

![Histogram showing the comparison between control and presynchronized groups for ovulation and pregnancy rates.]

- **Ovulation to 1st GnRH, %**
  - Control: 45.6%
  - Presynchronized: 60.8%
  - Statistical significance: $P < 0.05$

- **Pregnant, %**
  - Control: 90
  - Presynchronized: 6,946
  - Statistical significance: $P < 0.01$

*Bisinotto and Santos (2012) Reprod. Fert. Dev. 24: 258-266*
Use of Presynch for First AI Postpartum

65% of cows in estrus from 2 to 6 days

PGF$_{2\alpha}$ d -14
PGF$_{2\alpha}$ d 0
65% of cows in estrus from 2 to 6 days
Day 2
Day 3
Day 4
Day 5
Day 6
PGF$_{2\alpha}$ d 2
PGF$_{2\alpha}$ d 3
PGF$_{2\alpha}$ d 4
PGF$_{2\alpha}$ d 5
PGF$_{2\alpha}$ d 6
GnRH d 11

Day 5
Day 6
Day 7
Day 8
Day 9

Courtesy of W. W. Thatcher
Use of Presynch for First AI Postpartum

Presynch - Ovsynch

- PGF$_{2\alpha}$ at 37 ± 3 DIM
- PGF$_{2\alpha}$ at 51 ± 3 DIM
- GnRH at 63 ± 3 DIM
- PGF$_{2\alpha}$ at 70 ± 3 DIM
- GnRH at 72 ± 3 DIM
- AI 16-20 h later

P/AI = 42.7%

Ovsynch

- GnRH at 63 ± 3 DIM
- PGF$_{2\alpha}$ at 70 ± 3 DIM
- GnRH at 72 ± 3 DIM
- AI 16-20 h later

P/AI = 29.2%

Moreira et al. (2001) J. Dairy Sci. 84:1646-1659
Use of Double-Ovsynch for First AI Postpartum

### A. At first GnRH

<table>
<thead>
<tr>
<th>Proportion of cows</th>
<th>Double-Ovsynch</th>
<th>Presynch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &gt; P4 &lt; 1</td>
<td>3/32 (9.4%)</td>
<td>14/42 (33.3%)</td>
</tr>
<tr>
<td>1 &gt; P4 &lt; 3</td>
<td>15/42 (38.1%)</td>
<td></td>
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<tr>
<td>P4 ≥ 3</td>
<td>5/32 (15.6%)</td>
<td>13/42 (28.5%)</td>
</tr>
</tbody>
</table>

*P = 0.03, P < 0.01, P = 0.17*

Circulating progesterone concentration (P4, ng/mL)

**Souza et al. (2008) Theriogenology 70: 208-215**
## Use of Double-Ovsynch for First AI Postpartum

<table>
<thead>
<tr>
<th>Reference</th>
<th>Protocol</th>
<th>Overall</th>
<th>Prim.</th>
<th>Mult</th>
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<tbody>
<tr>
<td>Souza et al. (2008)</td>
<td>Double-Ovsynch (n = 157)</td>
<td>49.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>65.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37.5</td>
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<tr>
<td></td>
<td>Presynch-Ovsynch (n = 180)</td>
<td>41.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.3</td>
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<tr>
<td>Herlihy et al. (2012)</td>
<td>Double-Ovsynch (n = 837)</td>
<td>46.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.3&lt;sup&gt;A&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>Presynch-Ovsynch (n = 850)</td>
<td>38.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>42.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>34.3&lt;sup&gt;B&lt;/sup&gt;</td>
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<tr>
<td>Ribeiro et al. (2010)</td>
<td>Double-Ovsynch (n = 882)</td>
<td>52.2</td>
<td>50.9</td>
<td>53.6</td>
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<td>Presynch-Ovsynch (n = 871)</td>
<td>51.7</td>
<td>46.0</td>
<td>58.0</td>
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## Concurrent Use of Timed AI and Estrus Detection

<table>
<thead>
<tr>
<th>Program number</th>
<th>Program</th>
<th>First AI</th>
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<th>Second and subsequent AI</th>
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<tr>
<td></td>
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<td>ED before first TAI</td>
<td>CR ED before first TAI</td>
<td>CR TAI</td>
<td>ED before TAI</td>
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<tr>
<td>1</td>
<td>TAI 1(^3)</td>
<td>—</td>
<td></td>
<td>42</td>
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<tr>
<td>2</td>
<td>TAI+ED 2(^4)</td>
<td>30</td>
<td>25</td>
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<td>30</td>
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<tr>
<td>3</td>
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<td>38</td>
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<tr>
<td>4</td>
<td>TAI+ED 4</td>
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<td>25</td>
<td>36</td>
<td>50</td>
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<td>5</td>
<td>TAI+ED 5</td>
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<td>25</td>
<td>34</td>
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<td>6</td>
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<td>32</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
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<td>10</td>
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<td>30</td>
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<td>50</td>
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<td>11</td>
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<td>12</td>
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<td>30</td>
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<tr>
<td>13</td>
<td>TAI+ED 13</td>
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<td>30</td>
<td>30</td>
<td>80</td>
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<tr>
<td>14</td>
<td>TAI+ED 14</td>
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<td>40</td>
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</tr>
<tr>
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<td>TAI+ED 15</td>
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<td>35</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>16</td>
<td>TAI+ED 16</td>
<td>50</td>
<td>35</td>
<td>36</td>
<td>50</td>
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<tr>
<td>17</td>
<td>TAI+ED 17</td>
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<td>35</td>
<td>34</td>
<td>60</td>
</tr>
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<td>18</td>
<td>TAI+ED 18</td>
<td>70</td>
<td>35</td>
<td>32</td>
<td>70</td>
</tr>
<tr>
<td>19</td>
<td>TAI+ED 19</td>
<td>80</td>
<td>35</td>
<td>30</td>
<td>80</td>
</tr>
</tbody>
</table>

Concurrent Use of Timed AI and Estrus Detection

Detection and Reinsemination of Non-Pregnant Cows

-- Non-pregnancy diagnosis --
50 to 65% open cows

Return to estrus
- Reduces interval to reinsemination
- Minimizes costs with hormones
- Need for efficient and accurate ED

Timed AI
- Allow for all cows to be reinseminated between 3 and 10 days from the non-pregnancy diagnosis

Estrus detection and timed AI
Presynchronization before resynchronization:
Improves P/Al, but increase the interval between inseminations.

Presynchronization:
- GnRH: 22 days before AI
- PGF$_{2\alpha}$: 22 days before AI
- GnRH: 7 days before AI

P/Al = 24.5%

Non-pregnancy diagnosis:
- GnRH: 7 days before AI
- PGF$_{2\alpha}$: 7 days before AI
- GnRH: 7 days before AI

P/Al = 32.9%

Programs for Reinsemination of Non-Pregnant Cows

Cows inseminated in estrus = 44.1%

Programs for Reinsemination of Non-Pregnant Cows

Cows inseminated in estrus = 44.1%

P/AI

Reduced AI by ED = 37.1 vs. 50.6% ($P < 0.001$) Reduced AI by ED = 32.7 vs. 53.6% ($P < 0.001$)

No differences in P/AI

Herds with efficient/accurate estrus detection: Ovsynch-56 only

Programs for Reinsemination of Non-Pregnant Cows

<table>
<thead>
<tr>
<th></th>
<th>GGPG</th>
<th>P11GPG</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Insemination rate, $AHR$</td>
<td>Ref.</td>
<td>1.24</td>
<td>$&lt; 0.01$</td>
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<tr>
<td>Cows inseminated at timed AI, $%$</td>
<td>83.9</td>
<td>38.6</td>
<td>$&lt; 0.01$</td>
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<tr>
<td>Enrollment to AI, days</td>
<td>$15.0 \pm 0.2$</td>
<td>$13.0 \pm 0.4$</td>
<td>$&lt; 0.01$</td>
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<tr>
<td>P/AI day 67, $%$</td>
<td>37.0</td>
<td>35.4</td>
<td>0.70</td>
</tr>
<tr>
<td>Pregnant, $%$</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0 to 7 d after enrollment</td>
<td>3.6</td>
<td>17.7</td>
<td>$&lt; 0.01$</td>
</tr>
<tr>
<td>8 to 14 d after enrollment</td>
<td>1.6</td>
<td>5.7</td>
<td>$&lt; 0.01$</td>
</tr>
</tbody>
</table>

Improving Fertility in Cows during Resynchronization

No CL / CL < 15 mm + “cystic” → P/AI = 10.3% (n = 58)

CL > 15 mm → P/AI = 33.2% (n = 497)

\[ P = 0.001 \]
Improving Fertility in Cows during Resynchronization

18.9%

Improving Fertility in Cows during Resynchronization

- AHR = 1.01 (95% CI = 0.89-1.14)
- \( P = 0.89 \)

\[
P = 0.10
\]

\[
P = 0.46
\]

**Progesterone Concentrations During Follicular Growth**

- **Ovulation and Follicular emergence**
- **Luteolysis**
- **Synchronized ovulation**

**Progesterone**

- **GnRH**
- **PGF$_{2\alpha}$**
- **GnRH**
- **AI**
Effect of Progesterone Supplementation on P/AI

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>RR (95% CI)</th>
<th>% Weight</th>
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<tbody>
<tr>
<td>El-Zarkouny et al.</td>
<td>2004</td>
<td>1.88 (1.15-3.08)</td>
<td>1.17</td>
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<tr>
<td>El-Zarkouny et al.</td>
<td>2004</td>
<td>0.95 (0.73-1.25)</td>
<td>3.32</td>
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<tr>
<td>El-Zarkouny et al.</td>
<td>2004</td>
<td>0.81 (0.59-1.11)</td>
<td>2.53</td>
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<tr>
<td>Galvão et al.</td>
<td>2004</td>
<td>0.93 (0.73-1.18)</td>
<td>3.99</td>
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<tr>
<td>Melendez et al.</td>
<td>2006</td>
<td>1.28 (1.05-1.57)</td>
<td>5.18</td>
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<tr>
<td>Stevenson et al.</td>
<td>2006</td>
<td>1.22 (0.97-1.52)</td>
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<tr>
<td>Walsh et al.</td>
<td>2007</td>
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<td>Stevenson et al.</td>
<td>2008</td>
<td>1.31 (0.84-2.05)</td>
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<tr>
<td>Bartolome et al.</td>
<td>2009</td>
<td>1.13 (0.89-1.42)</td>
<td>4.21</td>
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<tr>
<td>Lima et al.</td>
<td>2009</td>
<td>1.08 (0.89-1.31)</td>
<td>5.23</td>
</tr>
<tr>
<td>Bisinotto et al.</td>
<td>2010</td>
<td>1.14 (0.93-1.39)</td>
<td>5.17</td>
</tr>
<tr>
<td>Chebel et al.</td>
<td>2010</td>
<td>1.13 (0.97-1.30)</td>
<td>7.38</td>
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<tr>
<td>Dewey et al.</td>
<td>2010</td>
<td>1.25 (0.96-1.62)</td>
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<tr>
<td>McDougall</td>
<td>2010</td>
<td>1.26 (1.06-1.50)</td>
<td>6.24</td>
</tr>
<tr>
<td>Herlihy et al.</td>
<td>2011</td>
<td>1.12 (0.94-1.32)</td>
<td>6.40</td>
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<tr>
<td>Bilby et al.</td>
<td>2013</td>
<td>0.92 (0.74-1.14)</td>
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<td>Chebel et al.</td>
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<td>1.02 (0.80-1.31)</td>
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<td>Colazo et al.</td>
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<td>0.89 (0.59-1.35)</td>
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<td>Bisinotto et al.</td>
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<td>5.88</td>
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<tr>
<td>Yilmazbas-Mecitoglu et al.</td>
<td>2004</td>
<td>1.09 (0.76-1.56)</td>
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<tr>
<td>RR_{D-L} Overall (F = 27.2%, P = 0.10)</td>
<td>1.09 (1.03-1.15)</td>
<td>100.00</td>
<td></td>
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<tr>
<td>with estimated predictive interval</td>
<td>(0.93-1.28)</td>
<td></td>
<td></td>
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<tr>
<td>RR_{K+H} Overall</td>
<td>1.10 (1.01-1.27)</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

**Without detection of estrus**

\[ RR_{K+H} = 1.20 \ (30.6 \text{ vs. } 38.6\% ) \]
\[ P < 0.001 \]

**With detection of estrus**

\[ RR_{K+H} = 1.04 \ (32.0 \text{ vs. } 33.4\% ) \]
\[ P = 0.52 \]

NOTE: Weights are from random-effects analysis.

Progesterone Supplementation and Synchrony of Ovulation

5 to 7% of cows in estrus
# Progesterone Supplementation and Synchrony of Ovulation

<table>
<thead>
<tr>
<th>Observations</th>
<th>PRID</th>
<th>No PRID</th>
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<tbody>
<tr>
<td>Total cows, N</td>
<td>294</td>
<td>314</td>
</tr>
<tr>
<td>Ovulated before TAI, N (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17 (5.8)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>35 (11.1)&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Response to PG, N (%)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>268 (96.8)</td>
<td>269 (96.4)</td>
</tr>
<tr>
<td>Ovulated after TAI, N (%)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>230 (85.8)</td>
<td>222 (82.5)</td>
</tr>
<tr>
<td>Overall synchronized, N (%)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>230 (78.2)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>222 (70.7)&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
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</table>

Côlazo et al. (2013) Theriogenology 79:833-841

[Diagram](#)
# Effect of Progesterone Supplementation on P/AI According to Estrous Detection and Presence of CL

<table>
<thead>
<tr>
<th>CL status</th>
<th>No detection of estrus</th>
<th>Detection of estrus</th>
<th>Detection of estrus</th>
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<tbody>
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<td>Control</td>
<td>P4</td>
<td>Control</td>
</tr>
<tr>
<td>No CL</td>
<td>27.6 (1,024)</td>
<td>37.2 (1,089)</td>
<td>27.1 (1,042)</td>
</tr>
<tr>
<td>CL present</td>
<td>38.0 (1,403)</td>
<td>44.9 (1,272)</td>
<td>34.1 (3,383)</td>
</tr>
</tbody>
</table>

*Effect of Progesterone Supplementation on P/AI According to Estrous Detection and Presence of CL*

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*Effect of Progesterone Supplementation on P/AI According to Estrous Detection and Presence of CL*

Supplementing Progesterone to Dairy Cows Without CL

CL present

CL absent

Study day

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225
Supplementing Progesterone to Dairy Cows Without CL

Detection of estrus (tail chalk)

Pregnancy Diagnosis: d 34 and 62

CL present

GnRH

PGF$_{2\alpha}$

GnRH + AI

2 CIDR (n = 946)

CL absent

GnRH

PGF$_{2\alpha}$

GnRH + AI

US

US

2CIDR (n = 218)

Control (n = 234)

Study day

-8

-3

-2

0

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225
Supplementing Progesterone to Dairy Cows Without CL

Detection of estrus (tail chalk)

Pregnancy Diagnosis: d 32 and 60

CL present

CL absent

GnRH

PGF$_{2\alpha}$

GnRH

PGF$_{2\alpha}$

GnRH

PGF$_{2\alpha}$

GnRH

CL present

GnRH

2 CIDR

GnRH

BCS / US

Pregnancy

Diagnosis:

d 32 and 60

Diuresis

(n = 640)

2CIDR

(n = 642)

Control

(n = 652)

Study day

-10  -9  -7  -5  -3  -0.7  0

Supplementing Progesterone to Dairy Cows Without CL

5-d Timed AI

Ovsynch-56

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225

Improving Luteal Regression During Timed AI

Ovulation and Follicular emergence

Luteolysis

Synchronized ovulation

Progesterone

GnRH

PGF$_{2\alpha}$

GnRH

AI
Delivery of PGF$_{2\alpha}$ During Timed AI Protocols


<table>
<thead>
<tr>
<th>Parity</th>
<th>1 PGF, % (no./no.)</th>
<th>2 PGF, % (no./no.)</th>
<th>Effect of PGF difference, % (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primiparous</td>
<td>39.3 (140/356)</td>
<td>40.6 (139/342)</td>
<td>+3.31% (0.39)</td>
</tr>
<tr>
<td>Multiparous</td>
<td>32.5 (296/910)</td>
<td>36.5 (333/913)</td>
<td>+12.31% (0.043)</td>
</tr>
<tr>
<td>$P$-value</td>
<td>0.04</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>34.4 (436/1266)</td>
<td>37.6 (471/1251)</td>
<td>+9.45% (0.049)</td>
</tr>
</tbody>
</table>

2$^{nd}$ and 3$^{rd}$ lactation
Delivery of PGF$_{2\alpha}$ During Timed AI Protocols

Ribeiro et al. (2012) Theriogenology 78:273–284

P/AI on day 64

32.6%

40.3%

$P = 0.04$
## Successful Implementation of Timed AI Programs

### Compliance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TAI-85</th>
<th>TAI-95</th>
<th>TAI-ED60-85</th>
<th>TAI-ED60-95</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR, %</td>
<td>57.0 ± 0.9^6</td>
<td>58.7 ± 1.0^4</td>
<td>90.6 ± 0.9^1</td>
<td>90.6 ± 1.1^1</td>
</tr>
<tr>
<td>CR1, %</td>
<td>24.9 ± 1.4^9</td>
<td>32.9 ± 1.4^1</td>
<td>25.4 ± 1.1^7</td>
<td>32.6 ± 1.2^2</td>
</tr>
<tr>
<td>CR2, %</td>
<td>19.4 ± 1.4^10</td>
<td>25.2 ± 1.7^9</td>
<td>28.3 ± 2.5^7</td>
<td>31.3 ± 2.5^3</td>
</tr>
<tr>
<td>CRav, %</td>
<td>20.0 ± 0.7^10</td>
<td>26.5 ± 0.8^7</td>
<td>24.3 ± 1.1^8</td>
<td>29.5 ± 1.4^3</td>
</tr>
<tr>
<td>PR, %</td>
<td>11.4 ± 0.4^9</td>
<td>15.5 ± 0.4^7</td>
<td>22.1 ± 0.9^3</td>
<td>26.8 ± 1.2^1</td>
</tr>
<tr>
<td>MDO, d</td>
<td>156^9</td>
<td>114^7</td>
<td>117^3</td>
<td>113^1</td>
</tr>
<tr>
<td>PP366, %</td>
<td>169 ± 19.5^9</td>
<td>137 ± 21.0^7</td>
<td>118 ± 3.9^3</td>
<td>113 ± 1.2^1</td>
</tr>
</tbody>
</table>

- $77/cow/year
- $33-42/cow/year

Adapted from Galvão et al. (2013) J. Dairy Sci. 96:2681-2693
Successful Implementation of Timed AI Programs

➢ Compliance

Protocols that are clear and easy to follow


http://www.id-ology.com/
Successful Implementation of Timed AI Programs
Thank You

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