Estrous Synchronization in Cattle

Estrous synchronization is a reproductive management tool that is particularly useful in artificial insemination (AI) and embryo transfer (ET) programs. It manipulates females’ estrous cycles with one or more hormones to bring cattle into estrus (heat) within a short period of time. Estrous synchronization is important to conveniently time the breeding of cattle in AI and ET programs.

Estrous synchronization with natural breeding can produce calves earlier in the calving season that will be heavier at weaning and have enhanced carcass values. Calves will be more uniform in age at weaning. Estrous synchronization also improves calf crop genetics when superior AI sires are used.

Estrous Synchronization Hormones

Understanding the roles of various hormones in the estrous cycle of cattle can help in understanding how estrous synchronization protocols work and where problems might arise. Refer to Mississippi State University Extension Service Publication 2616, “The Estrous Cycle of Cattle” for detailed information on the estrous cycle. Hormones common to many protocols include prostaglandin F2α (PG), progestins, and gonadotropin-releasing hormone (GnRH).

Prostaglandin is an injectable product and is commonly used in both cow and heifer synchronization protocols. The uterus produces prostaglandin, and the hormone ends the normal estrous cycle when a female is not pregnant. This allows females to return to heat, ovulate, and start a new cycle. Prostaglandins are effective in synchronizing heat only if females are cycling, but they are not effective on all days of the estrous cycle. Prostaglandin injected between day 5 and 20 of the estrous cycle regresses the corpus luteum (CL). Females must be cycling for PG administration to be effective. It can be used as the sole hormone administered to cattle for synchronization purposes. However, timed insemination protocols require additional hormones.

Progestins are a synthetic form of progesterone, a hormone that helps prepare for and maintain pregnancy. They include both melangestrol acetate (MGA®) and progesterone. Progestins can induce some noncycling females, including prepubertal heifers, to cycle and improve their chances of conceiving.

Administration of a progestin inhibits heat and blocks ovulation, serving as an “artificial” CL. Melangestrol acetate is used in some heifer synchronization protocols and is administered through feed. Inadequate intake can be a problem with MGA® use. Heifers must consume accurate daily amounts of MGA® for it to be effective for synchronization. It is also important to realize that the first ovulation after feeding MGA® for 14 days will not be a fertile ovulation, and females should not be inseminated after this estrus. This makes some of the MGA® protocols take longer.

Progesterone is administered via a vaginal insert of a progesterone-containing device (CIDR®, Controlled Internal Drug Release). It is easily inserted and removed and can be left in the animal for varying amounts of time, depending on the protocol. This can be done with both cows and heifers.
Gonadotropin-releasing hormone is an injectable hormone commonly used in both heifer and cow protocols. Increases in GnRH cause elevated pulsatile surges of follicle-stimulating hormone and luteinizing hormone. During the estrous cycle, GnRH causes follicle turnover and new follicle development. After the CL regresses, concentrations of progesterone decrease, causing pulses of GnRH to rise and a follicle to ovulate.

Commercial products used in estrous synchronization programs are listed below. Be sure to follow product label directions for storage, dosing, and administration. Many estrous synchronization products require a prescription from a veterinarian. Plan ahead to acquire these products before the breeding season.

### Table 1. Commercial Names for Common Bovine Estrous Synchronization Hormones

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Commercial Names</th>
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<tbody>
<tr>
<td>GnRH</td>
<td>Cystorelin®, Factrel®, Fertagyl®, OvaCyst®</td>
</tr>
<tr>
<td>PG</td>
<td>estroPLAN®, Estrumate®, In-Synch®, Lutalyse®, ProstaMate®</td>
</tr>
<tr>
<td>Progestin</td>
<td>MGA® (melangestrol acetate), CIDR® (progesterone)</td>
</tr>
</tbody>
</table>

### Estrous Synchronization Protocols

A variety of estrous synchronization protocols are available. Some are for use in both cows and heifers, whereas others are best used for one class of beef females or the other. Protocols differ in hormones used, method of hormone administration (injection, vaginal insert, or consumption through feed), number of injections, number of times cattle must be handled, timing of injections, and heat detection requirements. The cost of each protocol depends on the products used and labor needed.

Some estrous synchronization protocols call for heat detection followed by insemination approximately 12 hours after the first observation of standing heat. Peak heat activity typically occurs 48 to 72 hours after PG administration for most protocols. During this time period, devote at least 3 hours per day and preferably 5 to 6 hours per day to heat detection. Timed insemination of nonresponders (females not detected in heat) is typically recommended at 72 to 84 hours after PG with GnRH given at the time of insemination; this is frequently referred to as a “cleanup timed AI.” The main advantage to using timed AI is the shorter time spent on heat detection. Early responders observed in heat have a better chance of conceiving using heat detection followed by insemination compared with a single fixed-time insemination.

Estrous synchronization protocols from the Beef Reproduction Task Force are illustrated in this publication. This task force consists of animal scientists from several land-grant universities and provides an annual list of recommended protocols based on available research and field data. Comparisons of Beef Reproduction Task Force protocols for beef cows and beef heifers are presented below. Altering protocols or using alternative protocols should only be done with the advice of someone with extensive experience with synchronization protocols and should be supported by sound research data.
### Table 2. Comparison of Beef Cow Estrous Synchronization Protocols

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Labor</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Detection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Synch</td>
<td>Medium/High</td>
<td>Low</td>
</tr>
<tr>
<td>Select Synch + CIDR®</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>PG 6-day CIDR®</td>
<td>Medium/High</td>
<td>Medium</td>
</tr>
<tr>
<td>Heat Detection and Timed Artificial Insemination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Synch</td>
<td>Medium/High</td>
<td>Low</td>
</tr>
<tr>
<td>Select Synch + CIDR®</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>PG 6-day CIDR®</td>
<td>Medium/High</td>
<td>Medium</td>
</tr>
<tr>
<td>Fixed-time Artificial Insemination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-day CO-Synch + CIDR®</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>5-day CO-Synch + CIDR®</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>


### Table 3. Comparison of Beef Heifer Estrous Synchronization Protocols

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Labor</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Detection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Shot PG</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>7-day CIDR®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Low/Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Heat Detection and Timed Artificial Insemination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Synch + CIDR®</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>14-day CIDR®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Fixed-time Artificial Insemination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO-Synch + CIDR®</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>14-day CIDR®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**Beef Cow Protocols**

**Select Synch**

Day 0: Inject GnRH  
Days 6 to 13: Detect heat and breed  
Day 7: Inject PG in females not bred on days 6 to 7

**Select Synch + CIDR®**

Day 0: Insert CIDR®; Inject GnRH  
Day 7: Remove CIDR®, Inject PG  
Days 7 to 13: Detect heat and breed
**PG 6-day CIDR®**

Day 0: Inject PG  
Days 0 to 3: Detect head and breed  
Day 3: Insert CIDR® and inject GnRH for females that have not been bred  
Day 9: Remove CIDR®, Inject PG  
Days 9 to 12: Detect heat and breed

**Select Synch and Time AI**

Day 0: Inject GnRH  
Days 6 to 10: Detect heat and breed  
Day 7: Inject PG in females not bred on days 6 to 7  
Day 10: Inject GnRH and time breed females that have not been bred
**Select Synch + CIDR® and Time AI**

Day 0: Insert CIDR®, Inject GnRH  
Day 7: Remove CIDR®, Inject PG  
Days 7 to 10: Detect heat and breed  
Day 10: Inject GnRH and time breed females that have not been bred

**PG 6-day CIDR® and Time AI**

Day 0: Inject PG  
Days 0 to 3: Detect head and breed  
Day 3: Insert CIDR® and inject GnRH for females that have not been bred  
Day 9: Remove CIDR®, Inject PG  
Days 9 to 12: Detect heat and breed  
Day 12: Inject GnRH and time breed females that have not been bred
7-day CO-Synch + CIDR®
Day 0: Inject GnRH; Insert CIDR®
Day 7: Inject PG; Remove CIDR®
Day 10: Inject GnRH and time breed

5-day CO-Synch + CIDR®
Day 0: Inject GnRH; Insert CIDR®
Day 5: Remove CIDR®, Inject PG; Inject PG again 6 to 10 hours after 1st time
Day 8: Inject GnRH and time breed
**Beef Heifer Protocols**

**1 Shot PG**

Days 0 – 12: Detect heat and breed  
Day 5: Inject PG in females not detected in heat

**7-day CIDR®-PG**

Day 0: Insert CIDR®  
Day 7: Remove CIDR®, Inject PG  
Days 7 to 13: Detect heat and breed
**MGA®-PG**

Days 1 to 14: Feed MGA® (0.5 mg/head/day)
Day 33: Inject PG
Days 33 to 39: Detect heat and breed

**Select Synch + CIDR® and Time AI**

Day 0: Insert CIDR®, Inject GnRH
Day 7: Remove CIDR®, Inject PG
Days 7 to 10: Detect heat and breed
Day 10: Inject GnRH and time breed females that have not been bred

Cleanup AI 72 to 84 hours after PG
**MGA®-PG and Time AI**

Days 1 to 14: Feed MGA® (0.5 mg/head/day)
Day 33: Inject PG
Days 33 to 36: Detect heat and breed
Day 36: Inject GnRH and time breed females that have not been bred

**14-day CIDR®-PG and Time AI**

Day 0: Insert CIDR®
Day 14: Remove CIDR®
Day 30: Inject PG
Days 30 to 33: Detect heat and breed
Day 33: Inject GnRH and time breed females that have not been bred
**CO-Synch + CIDR®**

Day 0: Inject GnRH; Insert CIDR®
Day 7: Inject PG; Remove CIDR®
Day 9: Inject GnRH and time breed

**MGA®-PG**

Days 1 to 14: Feed MGA® (0.5 mg/head/day)
Day 33: Inject PG
Day 36: Inject GnRH and time breed females

**14-day CIDR®-PG**

Day 0: Insert CIDR®
Day 14: Remove CIDR®
Day 30: Inject PG
Day 33: Inject GnRH and time breed females
Management Considerations

Estrous synchronization programs require good management, regardless of what protocol is used. Cattle must be on good nutritional and herd health programs. Adequate cattle handling facilities must be available to restrain cattle safely for injections, vaginal insert administration, and breeding.

Pay attention to safety concerns when handling estrous synchronization products. Women of childbearing age and persons with respiratory problems, such as asthmatics, need to be particularly cautious when handling these products and may be best advised to avoid contact with these products altogether. Injections must be administered using the proper technique, product dosage, and timing. Be sure to follow label directions for storage and use, noting any refrigeration requirements and shelf life limitations. Sufficient feed trough space must be provided when using MGA® to ensure desired consumption rates amongst all cattle in the group. Some products used in estrous synchronization protocols may not be available at all local agricultural supply retailers and may instead need to be ordered in advance.

Effective heat detection programs must be implemented when heat detection is required in the synchronization protocol. Detailed information on heat detection is available in Mississippi State University Extension Service Publication 2610, “Estrus (Heat) Detection in Cattle.” A practical limitation of estrous synchronization programs is the number of head that can be inseminated at one time.

The Mississippi State University Extension Service developed and offers two beef cattle estrous synchronization decision tools to producers free of charge. An interactive estrous synchronization calendar is available as Microsoft Excel spreadsheet. It can be downloaded at msucares.com/livestock/beef/beefpubs.html. This interactive calendar is also available upon request as a BlackBerry® app. For more information on cattle reproduction or related topics, contact an office of the Mississippi State University Extension Service.

References