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EC00-279 Synchronizing Esetrus In Beef Cattle

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Synchronizing Estrus In Beef Cattle

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Introduction

Synchronization of estrus (heat) involves manipulating the estrous cycle of beef females in a herd so they can be bred at approximately the same time. There are several traditional protocols available for synchronizing estrus among beef females. Traditional protocols are designed to mimic or control the corpus luteum on the ovary. New protocols have been designed to control ovulation and/or the follicular waves that occur on the ovary during a 21-day estrous cycle. These new protocols include the use of prostaglandin plus the use of GnRH (Gonadotropin Releasing Hormone) and cause the release of hormones that have direct impact on follicle development and ovulation.

Estrous synchronization is a useful part of an artificial insemination program. Synchronization of estrus allows a producer to schedule labor for a concentrated time during the breeding and calving seasons. For the success of some estrous synchronization protocols, it is essential that females be exhibiting estrous cycles. This means that the ovary is producing hormones and an egg during a normal 21-day estrous cycle. Some estrous synchronization protocols can induce estrous cycles in anestrous (non-cycling) females that are close to initiating estrous cycles. However, regardless of the estrous synchronization program, they are not a substitute for a nutrition and herd health program specifically designed for the needs of the cow herd.

Products Used to Synchronize Estrus in Beef Cattle

Three primary groups of products are used to synchronize estrus and/or ovulation in beef cattle: prostaglandins, progestins, and gonadotropins (Table I). The prostaglandin products have the trade names of Lutalyse, Estrumate and IN SYNC, and each contain prostaglandin F2alpha (PGF2alpha) or an analogue of PGF2alpha. The progestin products include the norgestomet implant that is part of the Syncro-Mate B protocol and Melengestrol Acetate (MGA) which is included in the feed and consumed orally. The GnRH products are Cystorelin, Factrel, and Fertagyl. When

| Table I. Products to synchronize estrus in beef cattle. |
|------------|-------------|-------------------|
| **Product** | **Dose**     | **Approved Label Use** |
| Prostaglandins: | | |
| Lutalyse® | 5 mL, im | beef heifers and cows |
| Estrumate® | 2 mL, im | beef heifers and cows |
| IN-SYNC® | 5 mL, im | beef heifers and cows |
| Progestins: | | |
| Syncro-Mate B® | implant 6 mg, N°, inject 3 mg, N°, and 5 mg, EV, im | beef heifers and cows |
| MGA® | 0.5 mg/hd/day, orally | beef heifers and cows |
| GnRH: | | |
| Cystorelin® | 2 mL, im or iv | bovine females |
| Factrel® | 2 mL, im | dairy females |
| Fertagyl® | 2 mL, im or iv | bovine females |

*Strict adherence to label warnings and precautions should be observed. Follow Beef Quality Assurance (BQA) injection site procedures.
°Norgestomet
•Estradiol valerate
âMelengestrol acetate
*MGA is approved for suppressing estrus in feedlot heifers to improve performance in animals intended for slaughter. It does not carry FDA approval as a product to synchronize estrus.
†Products used to treat cystic follicles in beef and dairy females.
the Syncro-Mate-B protocol is used an estrogen, estradiol benzoate, is used as part of the protocol.

**Stages of the Estrous Cycle**

In a herd of non-pregnant cows or replacement heifers (12 - 16 months of age), females will be at various days of their 21-day estrous cycle or will be anestrus (not cycling). Under normal conditions, about 5 percent of the cyclic females will be in estrus on any given day. Cyclic females may be grouped into one of three categories based on structures present on their ovaries. Because the corpus luteum (CL) is present from day 6 of the estrous cycle until day 17, about 60 percent of females that are cycling will have a CL on their ovary at any one time. The remainder of the cyclic females will be developing a new CL (days 1 - 5) or regressing a CL (days 18 - 21). There also will be some females within a herd that are anestrus. During the 21-day estrous cycle, waves of follicles will grow and regress until one of the follicles emerges as the dominant follicle from which the egg will be ovulated. The primary hormone being produced by the follicle is estrogen and the primary hormone produced by the CL is progesterone. Both structures (CL and follicle) are on the ovary.

**How Estrous Synchronization Products Work**

Synchronization products control the estrous cycle in beef cattle by influencing structures that are present on the ovary. Some products will regress certain structures so that treated females come into heat about the same time. Other products target the ovary to cause follicles to grow, while still others mimic the hormone that is being produced by structures on the ovary.

Prostaglandins regulate a female's estrous cycle by causing "luteolysis" or regression of the CL when it is present on the ovary. A synthetic prostaglandin will mimic natural prostaglandin release from the uterus and will cause CL regression. Because the CL produces progesterone, prostaglandins eliminate the "progesterone block" and allow follicles to grow and subsequent ovulation to occur. Females with a CL on their ovary when they receive an injection of prostaglandin will usually exhibit estrus 2 to 5 days later. An injection of prostaglandins will only regress a CL that is 6 to 17 days old in the 21-day estrous cycle. After the progesterone block is removed, there is an increase in follicle growth and therefore, an increase in estrogen production and heat and subsequent ovulation will occur 2 to 5 days after the prostaglandin injection.

Estradiol benzoate, the estrogen used in the Syncro-Mate B protocol, will cause regression of a CL that is 1 to 5 days old. This is the primary reason for using estradiol instead of a prostaglandin.

Progestogenes, MGA and Norgestomet (in the Syncro-Mate-B protocol) "hold" the female from exhibiting heat. During a normal estrous cycle, the CL on the ovary produces progesterone. Feeding (MGA) or implanting (Syncro-Mate B) progesterone in females will play the same role as progesterone being produced by the CL. Progestins will not allow the follicle to ovulate or allow the female to exhibit heat until the synthetic progestin is removed.

GnRH causes the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH) from the anterior pituitary. The target tissue for LH and FSH is the ovary and are needed by the ovary to grow follicles that produce the egg. In a synchronization program, LH and FSH will grow follicles and also are a part of the process that causes ovulation (release of the egg from the dominant follicle). Because LH and FSH are involved in follicle maturation, these two hormones also support estrogen production from the follicle. Elevated blood concentrations of estrogen is associated with ovulation and bringing the animal into standing heat.

**Estrous Synchronization Protocols**

**Prostaglandin Protocols to Synchronize Estrus**

Females must be exhibiting estrous cycles for a synchronization protocol using prostaglandins to be successful. For prostaglandins to work effectively, females must be between days 6 and 17 of the estrous cycle. Prostaglandins will not regress an immature CL (day 1 to 5 of the estrous cycle). Because the cow is producing her own prostaglandin by day 18, an injection of prostaglandin will have no influence on the regression of this CL, even though it appears that there was a response. Synthetic prostaglandins appear to be more effective in regressing a mature (greater than day 12) CL as compared to a young CL and results in a "tighter" synchrony of the females.

There are four prostaglandin protocols used to synchronize estrus in beef females. Two of these programs require two injections of prostaglandin and two require just one injection.

**One Injection of Prostaglandin With 5 Days of Breeding**

Inject all females with prostaglandin on Day 0 and check for estrus and breed 12 hours after standing estrus (*Figure 1*). With a single injection of prostaglandin about 75 percent of the cycling females would be expected to display estrus during the next 2 to 5 days. Anestrus cows will not respond to this prostaglandin protocol because they do not have a CL present on the ovary.
One Injection of Prostaglandin With 10 Days of Breeding

Check for estrus and breed all females in standing estrus for the first five days of the breeding season (Figure 2). Inject all females with prostaglandin not previously bred at the end of day 5 and breed these females 12 hours after standing heat. By breeding for 5 days, none of the cows that receive the prostaglandin injection will be between day 1 and 5 of their estrous cycle. Cows that are cycling should display estrus within 2 to 5 days after the prostaglandin injection. This protocol can result in more than 90 percent of cyclic females being inseminated during the first 10 days of the breeding season.

Two Injections with Prostaglandin

The two injection programs for synchronization of estrus with prostaglandin allow for females to be inseminated after each prostaglandin injection or for insemination only after the second injection. In this

Figure 1. One injection prostaglandin protocol with 5 days of AI.

Figure 2. One injection prostaglandin protocol with 10 days of AI.
Inject Prostaglandin

Day 0

Figure 3. Two injection prostaglandin protocol with 10 days of AI.

protocol, an injection of prostaglandin is given to all females (Figure 3). After one injection, about 75 percent of the cycling females should be in heat during the next 5 days. Females that are detected in estrus should be inseminated 12 hours later. The animals that are not detected in heat and bred after the first injection should receive a second prostaglandin injection 11 or 14 days later and be bred 12 hours after they display standing estrus. Traditionally, the injections of prostaglandin are administered 11 days apart (Figure 4). However, recent data suggests that administering the second injection 14 days after the first injection has resulted in more females exhibiting estrus.

When breeding cows after each injection, be sure not to inject prostaglandin into females that were inseminated after the first injection. The two injection protocol should theoretically synchronize estrus in cyclic females within 2 to 5 days after the second injection. Synchronization responses of 70 to 80 percent of cows within a herd are common with this protocol, but can be highly variable depending on the number of anestrous cows in the herd. Timed insemination with this protocol is not recommended.

Key Points

- A nutrition program so that mature cows calve in a Body Condition Score of 5 and first-calf heifers in Body Condition Score of 6.
- A nutrition program for replacement heifer so they reach puberty and begin estrous cycles at least 3 weeks before the start of the breeding season.

Inject Prostaglandin

Day 0

Figure 4. Two injection prostaglandin protocol with AI after the second injection.
• Females must be exhibiting estrous cycles.
• Cows be at least 40 to 50 days post-calving.
• A good facility to restrain and handle cattle.
• Need trained people in detecting estrus (heat).
• Timed breeding is not recommended.

**MGA and Prostaglandin**

A low-cost system for estrous synchronization uses Melengestrol Acetate (MGA) and prostaglandin (Figure 5). MGA is a "progesterone-like" feed additive that suppresses estrus in feedlot heifers and is not approved by FDA to synchronize estrus. However, it is approved to suppress estrus in heifers in a feedlot and because heifers are usually confined in a dry lot during development and breeding, especially if artificial insemination is used, MGA can be used in this protocol. In this estrous synchronization procedure, MGA is fed at .5 mg/head/day for 14 days. Feeding MGA for 14 days allows cyclic females to proceed to day 18 of their estrous cycle on their own, but MGA holds the CL at day 18 until the MGA is removed from the ration. Females will exhibit estrus 2 to 5 days after withdrawal of the MGA. The estrus that occurs immediately after MGA feeding is a subfertile estrus and females should not be inseminated on this estrus. These females will ovulate an aged (and generally less fertile) egg and form a new CL. A single injection of prostaglandin administered 17 days after the MGA has been removed from the feeding program will regress the CL of the next estrous cycle. Most females will show estrus 48 to 72 hours after this prostaglandin injection. Inseminate cows about 12 hours after standing estrus.

This protocol is capable of inducing estrous cycles in some females that are not yet cycling. Mass mating all females or those that have not yet displayed heat at 72 hours (heifers) or 80 hours (cows) after the prostaglandin injection results in additional pregnancies. Some researchers have slightly modified this protocol. Instead of injecting females with prostaglandin 17 days after they have removed MGA from the ration, they wait until 19 days after MGA feeding to administer prostaglandin. Recent research indicates that there is a greater estrus response from females to this protocol because the CL is more mature at the time that prostaglandin is injected. Pregnancy rates also appear to improve with the 19-day protocol.

Care must be taken with this protocol to make sure all females consume MGA daily during the 14-day feeding period. This method is more often used in heifers than with cows because it takes 31 days to administer and most cows would not have calved early enough to respond to this treatment.

**Key Points**

• This program must begin 31 days before the start of the breeding season.
• Pregnancy rates are more variable when used on mature, lactating cows.
• Females need to be in good body condition.
• Females need to be fed a ration that MGA can be easily incorporated into.
• Each female consumes .5 mg of MGA daily.
• Need adequate bunk space.
• A high pregnancy rate is expected when females are bred 12 hr after standing estrus.
• Females can be time inseminated but conception rates are variable.
• MGA is approved by FDA to suppress estrus in feedlot heifers.
• Planning is needed well in advance of the start of the breeding season.
• Need a good facility to restrain and handle cattle.
• Need people trained in detecting estrus (heat).

Syncro-Mate B

Estrous synchronization using Syncro-Mate B consists of administering an injection and an ear implant on day 0 (Figure 6). The implant is removed on day 9. After the implant is removed, cows are observed for standing estrus and bred 12 hours later or time inseminated at 48-54 hours after implant removal.

The ear implant contains norgestomet (a progestosterone-like compound) and is placed subcutaneously in the backside of the ear. Before inserting the implant, it is helpful to clip the hair on the back of the ear, and disinfect the implant site. At the time the implant is being inserted, the animal is given an intramuscular injection that contains estradiol valerate and norgestomet. The norgestomet from the injection immediately blocks the release of hormones that cause ovulation and prevents females from displaying estrus. Release of norgestomet from the implant prevents estrus and ovulation over the next 9 days. The estradiol valerate in the injection causes regression of a mature CL and any new developing CL. Together, the estradiol valerate and norgestomet cause luteolysis and advances all cows to about day 19 of their estrous cycle and holds them there until the implant is removed. On day 9, when the norgestomet implant (progestosterone block) is removed, cycling returns with the release of hormones which stimulate follicular growth and estrogen secretion, and cows generally exhibit estrus within the next 1 to 4 days. Syncro-Mate B also induces estrous cycles in some anestrous cows.

There are three options for insemination using the Syncro-Mate B program:

1. All females are mass inseminated at a predetermined time. Females should be inseminated between 48 and 54 hours after implant removal without regard to time of estrus.
2. Animals are inseminated 12 hours after first observation of standing heat. This results in greater conception rates because the timing for insemination is more accurate and because non-responding cows are not inseminated.
3. A combination of the above two methods. Inseminate females that show estrus before 48 hours by the AM-PM rule and mass inseminate non-responding females at 48-54 hours after implant removal. Mass mating at this time can result in pregnancy in about 30 percent of non-responding females.

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Figure 6. Syncro-Mate B synchronization protocol.
Figure 7. Select Synch synchronization protocol.

Key Points
- Syncro-Mate B is effective in synchronizing estrus in cyclic cows and heifers.
- Females tend to have a tighter synchrony of estrus; therefore, timed breeding is possible.
- Remove implant on Day 9.
- Fertility can be influenced by stage of the estrous cycle when the protocol is initiated.
- Need females in good body condition.
- Need people trained detecting estrus (heat).
- This protocol can induce non-cyclic heifers and postpartum, anestrous cows to cycle, especially if combined with 48-hour calf removal.
- Need a good animal handling facility.

Select Synch

A new method for synchronizing estrus in beef cows (not for heifers) is to administer a GnRH injection followed one week later by an injection of prostaglandin (Figure 7). Females are observed for signs of estrus beginning 30 to 36 hours before and up to 6 days following the prostaglandin injection. Cows are inseminated 12 hours after standing estrus is observed. Most cows will exhibit estrus by day 4 after prostaglandin injection although some may exhibit estrus up to 6 days after prostaglandin. This protocol is referred to as the Select Synch protocol.

The GnRH injection results in ovulation of a dominant follicle and formation of a new CL. The GnRH injection also initiates development of a new follicle that will produce estrogen and ovulate following the prostaglandin injection. This protocol can initiate estrous cycles in some anestrous cows. A few cows (~8 percent) will exhibit estrus 36 hours before the prostaglandin injection, but the peak estrous response will be 2-3 days after the prostaglandin injection. This early estrus is fertile and cows can be inseminated. The prostaglandin injection is not necessary in cows that have already exhibited estrus and not yet bred, but it will not cause any harm, either. Do not inject prostaglandin in females that have been bred. Timed insemination is not recommended when using this protocol. The major benefits of the Select Synch protocol are the simplicity of the program and the ability to induce fertile estrous cycles in some cows that are not cycling.

Key Points
- Protocol not recommended for heifers.
- Cows should be at least 45 - 55 days postpartum.
- Need cows in good body condition.
- Use good heat detection technique.
- Time insemination not recommended.
- This protocol is targeted at follicle development on ovary.
- This protocol can induce estrus in non-cyclic, postpartum cows.
- Need good animal handling facility.

Co-Synch

Co-Synch protocol is slightly different from the Select Synch program in that the Co-Synch program is designed to synchronize ovulation and the Select Synch protocol is designed to synchronize estrus. The Co-Synch protocol involves administering the GnRH injection on day 0, prostaglandin on day 7, and a second GnRH injection on day 9 (48 hours after the
prostaglandin injection) at the same time that the females are mass inseminated (Co-Synch; Figure 8). This second GnRH injection initiates a fertile ovulation in cows that have not yet exhibited estrus. The Co-Synch protocol makes heat detection unnecessary and can yield pregnancy rates similar to breeding after detecting estrus. Waiting until day 10 to inject GnRH results in reduced pregnancy rates.

A slight modification to the Co-Synch protocol can increase the pregnancy rate 5 to 8 percent. On day 7, the same day that prostaglandin is injected, separate calves from the cows until cows are mass inseminated (Figure 9). Calf removal would be for 48 hours. When using the calf removal practice, it would be necessary to have secure pens or pastures so cows and calves remain separated for the 48 hour period. The calves will need clean water and high quality grass hay during the time that they are separated from their dams.
Key Points

- Protocol is not recommended for heifers.
- Need cows in good body condition.
- Will induce cycling in some non-cyclic cows.
- This protocol is used to synchronize the time of ovulation.
- Cows need to be at least 45 - 55 days postpartum.
- No heat detection is needed.
- 48 hour calf removal on day 7 can increase the pregnancy rate 5 to 8 percent.
- Because cows receive three injections, cost of this protocol is higher than other protocols.
- Need animal handling facility.

Costs and Potential Outcomes Of a Synchronization Program

Cost of using a synchronization program in your cow herd depends on many factors, including labor and facilities, products used in the different protocols, artificial insemination supplies, effectiveness of the protocol to synchronize estrus or ovulation that results in a pregnancy, and the cost of a clean-up bull. Table II illustrates costs of the synchronization protocols and an estimate of pregnancy rates for the different protocols. Pregnancy rate is calculated by dividing the number of cows that become pregnant when using the protocol by the total number of cows treated. The cost of an estrous synchronization can vary from $34 to $44 per pregnant female. These costs

Table II. Comparison of estrous synchronization protocols using Artificial Insemination (AI).

<table>
<thead>
<tr>
<th>Program</th>
<th>Number of Times Cattle Are Handled</th>
<th>Heat Detection (Days)</th>
<th>AI Breeding Period (Days)</th>
<th>Estimated Synchronization Pregnancy rate, %</th>
<th>Estimated Cost per Pregnant Female, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Injection Prostaglandin 5 day breeding</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>50</td>
<td>36</td>
</tr>
<tr>
<td>One Injection Prostaglandin 10 day breeding</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>55</td>
<td>35</td>
</tr>
<tr>
<td>Two Injection Prostaglandin with AI After Each Injection</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>50</td>
<td>37</td>
</tr>
<tr>
<td>Two Injection Prostaglandin with AI After 2nd Injection</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>50</td>
<td>39</td>
</tr>
<tr>
<td>MGA® and Prostaglandin</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>55</td>
<td>34</td>
</tr>
<tr>
<td>Syncro-Mate-B®</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td>Syncro-Mate-B® with Timed AI</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>44</td>
</tr>
<tr>
<td>Select Synch</td>
<td>2 or 3</td>
<td>7</td>
<td>7</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td>Co-Synch</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>55</td>
<td>46</td>
</tr>
<tr>
<td>Co-Synch with 48 Hr. Calf Removal</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>60</td>
<td>43</td>
</tr>
</tbody>
</table>

*Pregnancy rate defined as the number of pregnant females divided by the number of females that received the synchronization treatment.

*These costs can be compared to $32 for natural service without synchronization (details in the 1990 Nebraska Beef Report).
can be compared to $32 natural service by bulls without synchronization (details are in the 1990 Nebraska Beef Report).

Synchronization of females should result in calves being born earlier in the calving season and thus, older, heavier, and more uniform calves at weaning. Cows that calve earlier in the calving season have more time to recover before the start of the next breeding season and thus are more likely to exhibit estrous cycles by the start of breeding. Increasing the number of cows cycling at the onset of the breeding season may translate to higher pregnancy rates and lower heifer replacement rates. An estrous synchronization program coupled with AI has the potential to provide an economic edge to the cow/calf producer by improving herd quality, calf crop uniformity, use of sexed semen, cloned embryos and potentially lower annual production costs.

**Success of Synchronization Program**

A synchronization program is not a substitute for a good nutrition program for the cow herd. Success of a synchronization program will depend on a nutrition and herd health program that has been specifically designed for the females in the herd. A successful program requires: (1) females exhibiting regular estrous cycles; (2) healthy animals that are free from disease and on a good nutrition program; (3) a willingness by producers to learn how to use the product(s) and program; (4) a working facility with a small crowding corral, a holding alley and chute; (5) providing and preparing for extra labor needs (6) accurate and thorough detection of estrus; and (7) the individual identification of females, with accurate recordkeeping.

When using products for estrous synchronization that need to be injected into the female, use Beef Quality Assurance injection site procedures. When injecting into the neck muscle, consider using a longer needle (1 1/2 inch). It appears that it is more difficult to get to the neck muscles and using the longer needle will aid in depositing the product in the muscle. For these products to act effectively, they must be deposited in the site or sites listed on the label.

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**Note:** Use of commercial products’ names does not imply endorsement.