

# Synchronizing Estrus In



# BEEF CATTLE

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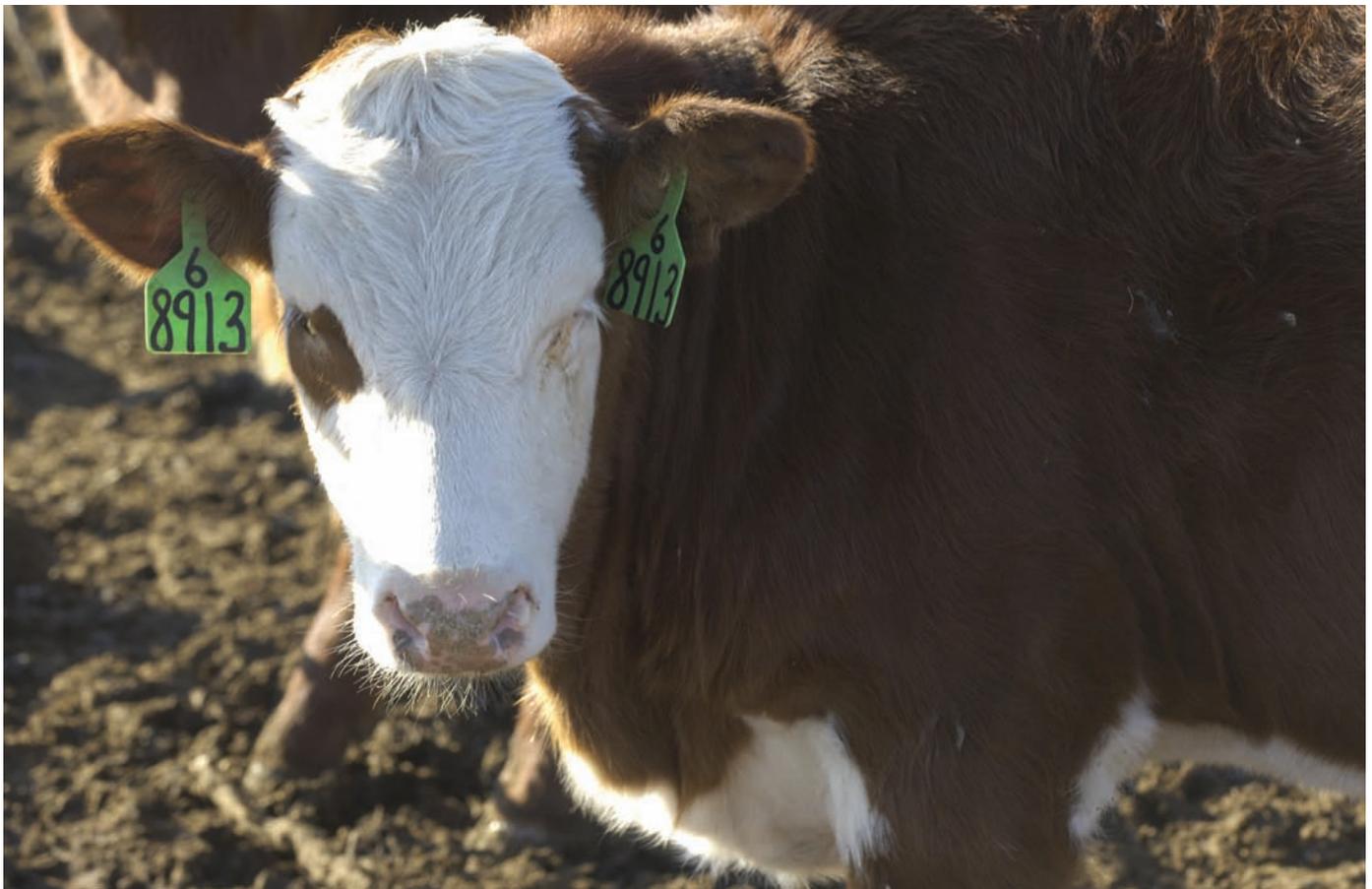
## Introduction

**S**ynchronization of estrus (heat) means manipulating the estrous cycle of beef females in a herd so breeding can occur at approximately the same time. Synchronization protocols use products that mimic hormones naturally produced to alter the timing of estrus by affecting structures on the ovaries (follicles and corpus luteum ([CL])).

Estrous synchronization can be useful in both artificial insemination (AI) and natural service programs. By synchronizing estrus, a producer can schedule labor for a concentrated time during breeding and calving seasons.

For estrous synchronization protocols to be successful, females must be healthy, on an adequate plane of nutrition, and, for some protocols, exhibiting estrous cycles before the protocol begins. This means that estrus and ovulation are occurring during a normal 21-day (19-day for heifers) estrous cycle.

Some estrous synchronization protocols can induce estrous cycles in anestrus (non-cycling) females that are close to initiating estrous cycles. However, regardless of the estrous synchronization program, the protocols are not a substitute for a good nutrition and herd health program.



## Stages of Estrous Cycle

In a herd of non-pregnant cows or replacement heifers (12 to 16 months of age), females will be at various days of their 21-day estrous cycle or will be in anestrus (not cycling). Under normal conditions, about 5 percent of the cyclic females will be in estrus (heat) on any given day.

Cyclic females may be grouped into one of three categories based on structures present on their ovaries.

- One group is females with an active (responsive to prostaglandin) corpus luteum (CL) present. It includes females that are somewhere between day 6 and day 17 of the estrous cycle. About 60 percent of cyclic females will have an active CL on their ovary.

- The remainder of the cyclic females will either be developing a new CL (days 1 to 5) or regressing a CL (days 18 to 21).

- There will also be a group of females that are anestrus.

During the estrous cycle, waves of follicles will grow and regress on the ovary until one emerges as the dominant follicle, from which the egg will be ovulated. Two hormones are produced in the ovulation process — estrogen and progesterone. The primary hormone produced by the follicle is estrogen. Progesterone is produced by the CL on the ovary.

More information on the process is available at the UNL Beef Web site <http://beef.unl.edu/learning/estrous.shtml>.

## Products Used to Synchronize Estrus in Beef Females

Three primary groups of products are used to synchronize estrus and/or ovulation in beef cattle:

- prostaglandins
- progestins and
- gonadotropin releasing hormone (*Table I*)

The prostaglandin products have the trade names of EstroPLAN™, Estrumate®, IN-SYNCH™, Lutalyse®, and ProstaMate™, and each contains prostaglandin F<sub>2α</sub> (PGF<sub>2α</sub>) or one of its analogues.

The trade names of progestin products include CIDR®, which is vaginally inserted, and Melengestrol Acetate (MGA), included in the feed and consumed orally. MGA is approved to suppress estrus in heifers in a feedlot. Because heifers are usually confined in a dry lot to implement a synchronization protocol, MGA can be used in synchronization protocols. Products that mimic gonadotropin releasing hormone (GnRH) are marketed under the names Cystorelin®, Factrel®, Fertagyl®, and Ovacyst™.

When products for estrous synchronization need to be injected, use Beef Quality Assurance guidelines and procedures. When administering an injection into the neck muscle, consider using a 1½-inch, 18-gauge needle, which aids in depositing the product in the muscle. For products to work effectively, they must be deposited in the site(s) listed on the label.

**Table I. Products to synchronize estrus in beef cattle.<sup>a</sup>**

<i>Product</i>	<i>Dosage</i>	<i>Approved Label Use</i>
<b>Prostaglandins:</b>		
EstroPLAN	2 ml, im	beef heifers and cows
Estrumate	2 ml, im	beef heifers and cows
IN-SYNCH	5 ml, im	beef heifers and cows
Lutalyse	5 ml, im	beef heifers and cows
ProstaMate	5 ml, im	beef heifers and cows
<b>Progestins:</b>		
CIDR <sup>b</sup>	1/hd, intravaginally	beef heifers and cows
MGA <sup>c</sup>	0.5 mg/hd/day, orally	beef heifers (estrus suppression only <sup>d</sup> )
<b>GnRH:</b>		
Cystorelin <sup>e</sup>	2 ml, im or iv	bovine females
Factrel <sup>e</sup>	2 ml, im	dairy females
Fertagyl <sup>e</sup>	2 ml, im or iv	bovine females
OvaCyst <sup>e</sup>	2 ml, im or iv	dairy females

<sup>a</sup>Strict adherence to label warnings and precautions should be observed. Follow Beef Quality Assurance (BQA) guidelines.

<sup>b</sup>Controlled intervaginal drug release

<sup>c</sup>Melengestrol acetate

<sup>d</sup>MGA is approved for suppressing estrus in feedlot heifers to improve performance in animals intended for slaughter.

<sup>e</sup>Products used to treat cystic follicles in beef and dairy females

## How Estrous Synchronization Products Work

Synchronization products control the estrous cycle in beef cattle by influencing structures present on the ovary.

- **Prostaglandins** regulate a female's estrous cycle by causing "luteolysis" or regression of the CL when it's present on the ovary. An injection of synthetic prostaglandin will cause regression of a CL that is 6 to 17 days old in the 21-day estrous cycle. When females with a CL on their ovary receive an injection of prostaglandin, they will usually exhibit estrus 2 to 5 days later.

The CL produces **progesterone**, which inhibits estrus. By regressing the CL, follicular growth and, subsequently, ovulation can occur.

After the progesterone block is removed, follicle growth increases. Therefore, estrogen production increases. Estrus and subsequent ovulation will occur two to five days later.

- **Progesterone and MGA** "hold" the female from exhibiting estrus. Whether the female is fed a progestin (MGA) or has the progestin vaginally inserted (CIDR), synthetic progesterone works the same way as the natural progesterone produced by the CL. Progestin keeps the follicle from ovulating and the female from exhibiting estrus until the synthetic progestin is physically or nutritionally removed.

- **Gonadotropin releasing hormone (GnRH)** causes the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH) from the female's anterior pituitary gland. These two hormones target the ovary, which needs these hormones to grow follicles that produce the egg.

In a synchronization program, LH and FSH will grow follicles and also play a part in causing 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 concentration of estrogen is associated with ovulation and bringing the animal into standing estrus.

## Estrous Synchronization Protocols for Heifers

Most of the following synchronization protocols are recommended by the Beef Reproduction Task Force. The first set of protocols uses heat detection (HD) to determine when heifers are to be inseminated. These protocols tend to be less expensive and have a wide range of labor needs.

The second group of protocols incorporates both heat detection and timed insemination (TAI). These protocols tend to be moderate to high in cost and have moderate labor requirements. The final group of protocols use a specific time during the protocol to establish when to inseminate heifers. These protocols tend to have moderate to high costs and labor requirements.

### Heat Detection (HD) Protocols

**One-Injection Prostaglandin with HD** (Figure 1). Check for estrus and inseminate all heifers in standing estrus for the first five days of the breeding season. Inject all heifers not previously bred at the end of day 5 with prostaglandin and inseminate these females 12 hours after standing heat.

By breeding for 5 days, none of the females receiving the prostaglandin injection will be between day 1 and 5 of their estrous cycle. Heifers 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 12 days of the breeding season.

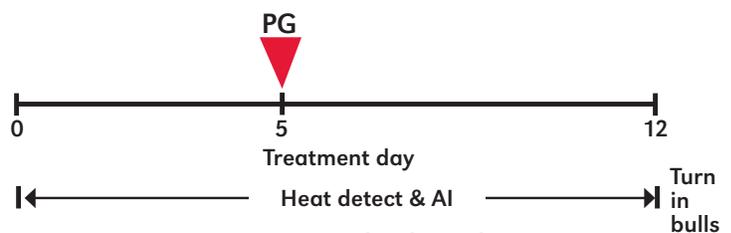


Figure 1. One-injection prostaglandin with HD.

**Two-Injection Prostaglandin with HD** (Figure 2). An injection of prostaglandin is given to all heifers on the first day (day 0), and on day 14, they receive a second prostaglandin injection. Heifers are observed for estrus for the following 5 days and inseminated 12 hours after they display standing estrus. The two-injection protocol should, theoretically, synchronize estrus in cyclic females within 2 to 5 days after the second injection. Timed artificial insemination when using this protocol is not recommended. Only heifers that are cycling will respond to this protocol.

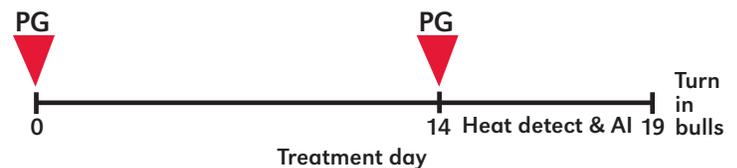


Figure 2. Two-injection prostaglandin with HD.

**CIDR-PG with HD** (Figure 3). In this heifer protocol prostaglandin is used in combination with CIDR. On the first day (day 0), all heifers receive a CIDR, which remains in the heifer for 7 days. On the 7<sup>th</sup> day, the CIDR is removed and all heifers are injected with prostaglandin. From day 7 through day 13 of the protocol, observe heifers for standing estrus and inseminate 12 hours after estrus is detected.

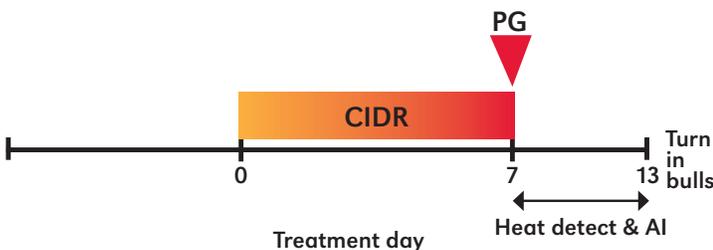


Figure 3. CIDR-PG with HD.

**MGA-PG with HD** (Figure 4). In this procedure, MGA is fed 0.5 mg/head/day for 14 days. MGA mimics progesterone produced by the CL and does not allow heifers to come into estrus. Heifers will exhibit estrus two to five days after withdrawal of the MGA. The estrus that occurs immediately after MGA feeding is subfertile and heifers should not be inseminated on this estrus. These heifers will ovulate an aged, less fertile egg.

A single injection of prostaglandin administered 19 days after the MGA has been removed from the feeding program will regress the CL. Observe heifers for standing estrus for six days following the prostaglandin injection. Most heifers will show estrus 48 to 72 hours after this injection. Inseminate heifers about 12 hours after standing estrus is observed.

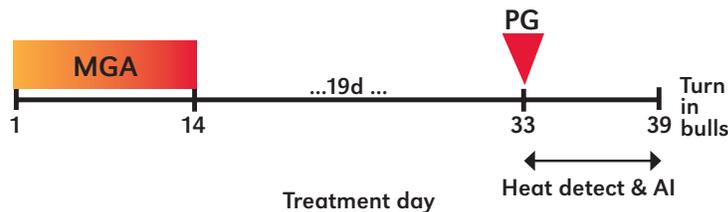


Figure 4. MGA-PG with HD.

### Heat Detection (HD) and Timed Insemination (TAI)

**Select Synch + CIDR HD and TAI** (Figure 5). This is a fairly complex protocol that requires three separate injections as well as CIDR insertion. On day 0, all heifers are injected with GnRH and also receive a CIDR. On day 7, the CIDR is removed, and all heifers are injected with prostaglandin. From day 7 through day 10, heifers are observed for estrus and inseminated 12 hours after estrus is detected. On day 10 of the protocol, or between 72 and 84 hours (3 to 3.5 days) following the prostaglandin injection, heifers that have not yet been inseminated are given another GnRH injection and mass-inseminated.

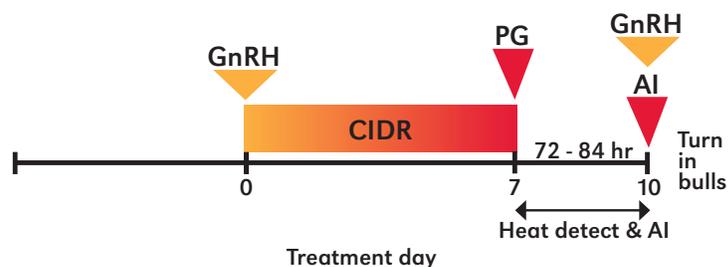


Figure 5. Select Synch + CIDR HD & TAI.

## Glossary

**Anestrus** is when a heifer is in a non-cycling status.

**Estrous** is an adjective that modifies the noun (for example: estrous cycle, estrous synchronization).

**Estrus** is a noun. A beef female that is standing ready to be serviced is in estrus. Same meaning as heat.

The **CL** (Corpus luteum) is located on the ovary and is the structure that results after ovulation occurs from the follicle. The CL produces progesterone, which inhibits estrus.

**Estrogen** is the primary hormone produced by ovarian follicles.

**FSH** (Follicle stimulating hormone) is produced from the anterior pituitary.

**LH** (Luteinizing hormone) is produced from the anterior pituitary.

**Progesterone** is produced by the CL on the ovary. The hormone of pregnancy. Holds the female from exhibiting estrus.

**MGA-PG HD and TAI** (Figure 6). This protocol is very similar to the MGA-PG HD protocol. MGA is fed at 0.5 mg/head/day for 14 days. MGA doesn't allow heifers to cycle. Heifers will exhibit estrus two to five days after withdrawal of the MGA.

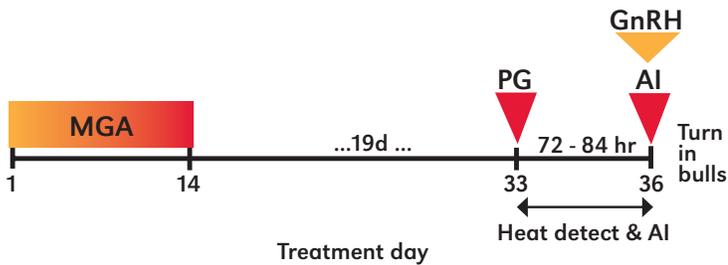


Figure 6. MGA-PG HD & TAI.

The estrus that occurs immediately after MGA feeding is a subfertile estrus and heifers should not be inseminated on this estrus.

A single injection of prostaglandin administered 19 days after the MGA has been removed from the feeding program will regress the CL. Observe heifers for standing estrus for the next three days following the prostaglandin injection. Inseminate heifers about 12 hours after standing estrus is observed. Between 72 and 84 hours (3 to 3.5 days) following the prostaglandin injection, inject all heifers that have not yet been inseminated with GnRH and mass-inseminate.

**14-day CIDR-PG HD & TAI** (Figure 7). A CIDR is in place for 14 days. Sixteen days (day 30 of the initiation of the protocol) after CIDR removal, heifers are injected with a single dose of prostaglandin. Detect heifers for estrus and inseminate 12 hours after detecting estrus. On day 33 of the protocol (70 to 74 hours

after the prostaglandin injection), inject heifers that have not been inseminated with GnRH and mass-inseminate.

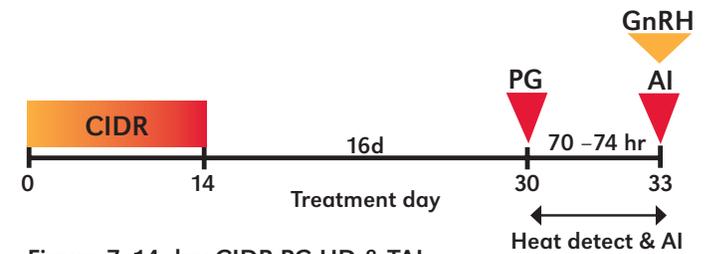


Figure 7. 14-day CIDR-PG HD & TAI.

### Timed Insemination (TAI)

**CO-Synch + CIDR TAI** (Figure 8). This protocol requires three separate injections and the use of a CIDR. On day 0 of the protocol, all heifers receive a CIDR and a GnRH injection. On day 7, the CIDR is removed and heifers receive an injection of prostaglandin. Between 52 and 56 hours (slightly more than two days) following the prostaglandin injection, heifers are injected with GnRH again and are mass-inseminated (day 9 of the protocol).

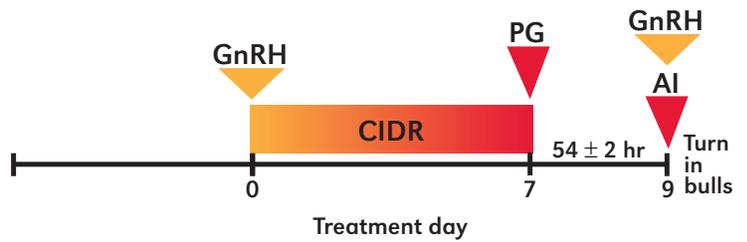


Figure 8. CO-Synch & CIDR TAI.

## Glossary

**Prostaglandins** regulate a female's estrous cycle by causing luteolysis or regression of the CL when it is on the ovary. Commercial prostaglandin products include *estroPLAN*, *Estrumate*, *IN-SYNCH*, *Lutalyse*, and *ProstaMate*.

**Progestins** regulate a female's estrous cycle by not allowing the follicle to ovulate or allow the female to exhibit heat until the synthetic progestin is removed. Commercial progestin products include CIDR (vaginally inserted) and *Melengestrol Acetate (MGA)*.

**GnRH** (Gonadotropin-Releasing Hormone) causes release of LH and FSH from the anterior pituitary. Commercial gonadotropin-releasing hormone products include *Cystorelin*, *Factrel*, *Fertagyl*, and *OvaCyst*.

**MGA-PG TAI** (Figure 9). This protocol is much like the other two MGA protocols discussed previously. MGA is fed at 0.5 mg/head/day for 14 days. Heifers will exhibit estrus two to five days after withdrawal of the MGA.

The estrus that occurs immediately after MGA feeding is a subfertile estrus and heifers should not be inseminated on this estrus.

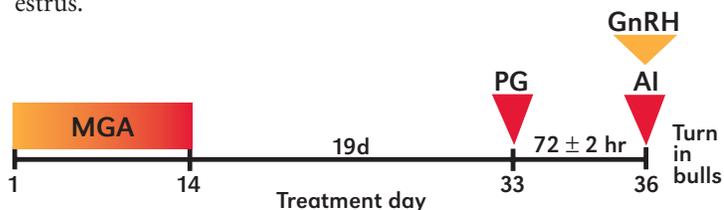


Figure 9. MGA-PG TAI.

A single injection of prostaglandin administered 19 days after the MGA has been removed from the feeding program regresses the CL. Between 70 and 74 hours (about three days) following the prostaglandin injection, inject all heifers with GnRH and mass-inseminate them.

**14-day CIDR-PG Select TAI** (Figure 10). This protocol requires a long time span and two separate injections, as well as the use of a CIDR. On day 0, all heifers receive a CIDR, which is removed 14 days later. On day 30 of the protocol, all heifers are injected with prostaglandin. Finally, between 64 and 68 hours (about three days) following the prostaglandin injection, all heifers receive a GnRH injection and are mass-inseminated (day 33 of the protocol).



Figure 10. 14-day CIDR-PG TAI.

## Comparison of Heifer Protocols

A summary of cost, labor, and time requirements of the various heifer protocols is presented in Table II. Note differences in cost, labor, and length (in days) of each protocol. Prior planning is needed to successfully implement protocols.

## Estrous Synchronization Protocols for Cows

The main categories of protocols that apply to heifers are the same for cows, but the protocols themselves differ. However, MGA is not approved for use in synchronization protocols for cows.

### Heat Detection (HD)

**Two-Injection Prostaglandin with HD** (Figure 11). An injection of prostaglandin is given to all cows on day 0 with a second injection on day 14. Cows are observed for estrus for the following five days and inseminated 12 hours after they display standing estrus. The two-injection protocols should, theoretically, synchronize estrus in cyclic cows within two to five 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 anestrus cows in the herd. Timed insemination is not recommended when using this protocol.

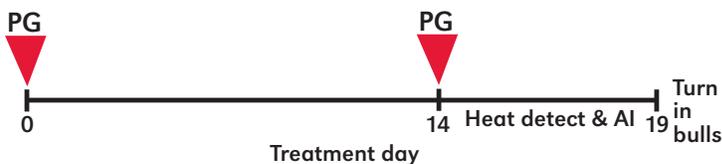


Figure 11. Two-injection prostaglandin with HD.

Table II. Comparison of beef heifer estrus synchronization protocols.

Protocol	Cost <sup>a</sup>	Labor Required <sup>a</sup>	Length of Protocol
<b>Heat Detection</b>			
1 Shot PG HD	Low	High	12 days
2 Shot PG HD	Low	Medium	19 days
CIDR-PG HD	Medium	Medium	13 days
MGA-PG HD	Low	Low/Medium	39 days
<b>Heat Detection and Timed Insemination</b>			
Select Synch + CIDR HD & TAI	High	Medium	10 days
MGA-PG HD & TAI	Medium	Medium	36 days
<b>Timed Insemination</b>			
CO-Synch + CIDR TAI	High	Medium	9 days
MGA-PG TAI	Medium	Medium	36 days
CIDR Select TAI	High	Medium/High	33 days

<sup>a</sup>Information from Beef Reproduction Task Force, except 2 Shot PG protocol

**Select Synch with HD** (Figure 12). For the Select Synch protocol, GnRH is injected on day 0. Beginning on day 6 and continuing through day 13 of the protocol, check for estrus. Inseminate females 12 hours after observing estrus. On day 7, inject all noninseminated cows with prostaglandin.

Most cows will have exhibited estrus by the fourth day after the prostaglandin injection, although some may exhibit estrus up to six days after prostaglandin injections.

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 (about 8 percent) will exhibit estrus 36 hours before the prostaglandin injection, but the peak estrous response will be two to three days after the prostaglandin injection.

This early estrus is fertile and cows can be inseminated. **Do not** inject prostaglandin in females that have already been inseminated. Timed insemination is not recommended when using this protocol.

The major benefits of the Select Synch protocol are the low cost and simplicity of the program and the ability to induce fertile estrous cycles in some cows that are not cycling; however, labor requirements are relatively high.

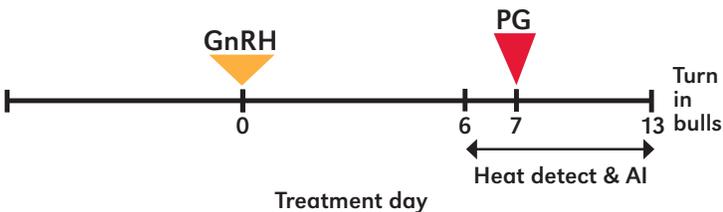


Figure 12. Select Synch with HD.

**Select Synch + CIDR with HD** (Figure 13). As its name implies, the Select Synch with CIDR protocol is very similar to the Select Synch protocol with the additional use of a CIDR. Cows are injected with GnRH and receive a CIDR on day 0. On day 7, the CIDR is removed, and all the cows receive an injection of prostaglandin. Cows are monitored for estrus from day 7 until day 13 and are inseminated 12 hours after standing estrus is observed.

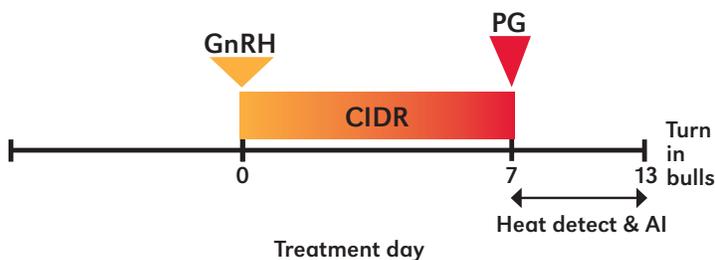


Figure 13: Select Synch + CIDR with HD.

## Heat Detection and Timed Insemination

**Select Synch with HD and TAI** (Figure 14). With this protocol, all cows are given an injection of GnRH on day 0. Beginning on day 6 and continuing through day 10, cows are observed for estrus and are inseminated 12 hours after standing estrus. On day 7, cows that have not yet been inseminated are injected with prostaglandin.

Between 72 and 84 hours (3 to 3.5 days) following the PG injection, all remaining cows that have not yet expressed estrus are given an injection of GnRH and inseminated. This requires non-responding cows to be processed three separate times.

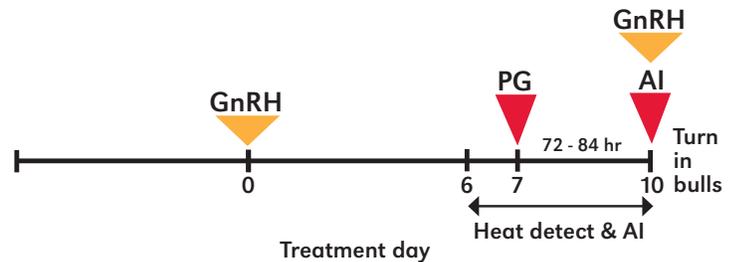


Figure 14. Select Synch with HD and TAI.

**Select Synch + CIDR with HD and TAI** (Figure 15). This protocol incorporates the CIDR along with three separate injections. On day 0, cows are injected with GnRH and receive a CIDR. On day 7, the CIDR is removed and all cows receive an injection of prostaglandin. From day 7 through day 10 of the protocol, cows are observed for estrus and are inseminated 12 hours following estrus detection. Between 72 and 84 hours (3 to 3.5 days) following the prostaglandin injection, all cows not yet inseminated are given a second GnRH injection and are mass-inseminated (day 10 of the protocol).

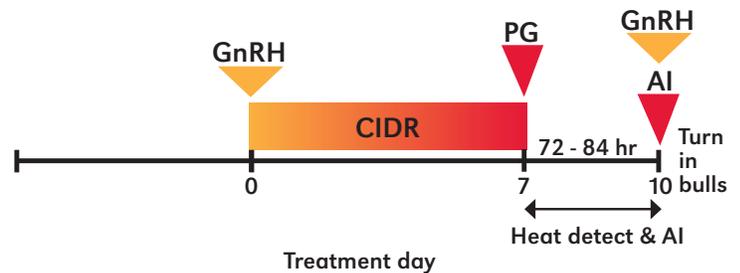


Figure 15. Select Synch + CIDR with HD and TAI.

## Timed Insemination

**Seven-day CO-Synch + CIDR TAI** (Figure 16). With this protocol, three separate injections are given in addition to a CIDR. Each cow is given a CIDR and a GnRH injection on day 0. On day 7, the CIDR is removed and each cow receives an injection of prostaglandin. Between 60 and 66 hours (about 2.5 days) following the prostaglandin injection, all females are given an injection of GnRH and the whole group is mass inseminated (day 10 of the protocol).

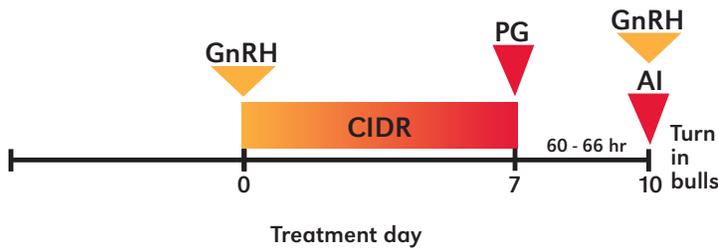


Figure 16. Seven-day CO-Synch + CIDR® TAI.

**Five-day CO-Synch + CIDR TAI** (Figure 17). This protocol is one of the most complex with four injections and a CIDR as part of the protocol. On day 0, all cows receive a CIDR and an injection of GnRH. On day 5, the CIDR is removed and all females receive an injection of prostaglandin. Between 6 and 10 hours following the first prostaglandin injection, a second injection of prostaglandin is administered to all cows. Between 70 and 74 hours (about 3 days) following the initial prostaglandin injection, all cows are given an injection of GnRH and mass-inseminated (day 8 of the protocol).

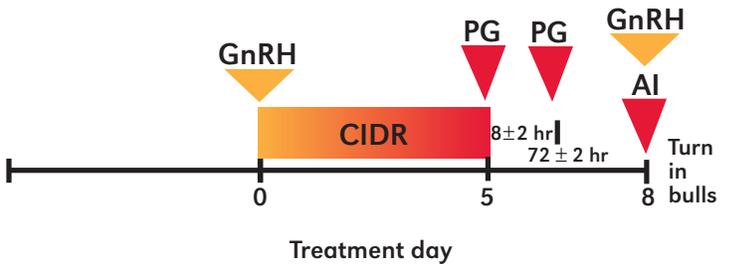


Figure 17. Five-Day CO-Synch + CIDR TAI.

Table III. Comparison of beef cow estrus synchronization protocols.

Protocol	Cost <sup>a</sup>	Labor Required <sup>a</sup>	Length of Protocol
Heat Detection			
2 Shot PG HD	Low	Medium	19 days
Select Synch HD	Low	Medium/High	13 days
Select Synch + CIDR HD	High	Medium	13 days
Heat Detection and Timed Insemination			
Select Synch HD & TAI	Low	Medium/High	10 days
Select Synch + CIDR HD & TAI	High	Medium	10 days
Timed Insemination			
7 day CO-Synch + CIDR TAI	High	High	10 days
5 day CO-Synch + CIDR TAI	High	High	8 days

<sup>a</sup>Information from Beef Reproduction Task Force, except 2-Shot PG protocol

### Disclaimer

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by University of Nebraska–Lincoln Extension is implied for those mentioned.

## Comparison of Cow Protocols

A summary of the cost, labor, and time requirements of the various asynchronization protocols for cows is presented in *Table III*. Note differences in cost, labor needed, and length (in days) of each protocol. Prior planning is needed to successfully implement protocols.

### Using Natural Service with Estrous Synchronization

Not many estrous synchronization protocols have been tested using natural service. One trial reported in the *1990 Nebraska Beef Cattle Report* (pg 35) tested synchronization using MGA and prostaglandin in heifers that were either artificially inseminated or serviced naturally.

MGA was fed for 14 days (0.5 mg/hd/da), then 16 days after the feeding of MGA ended, heifers were injected with prostaglandin and serviced naturally (*Figure 18*).

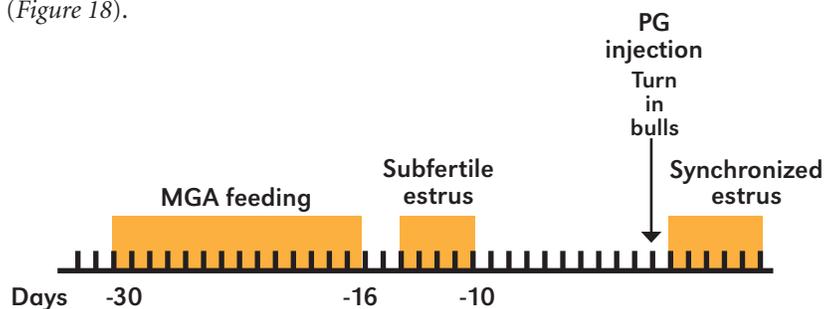


Figure 18. MGA-PG natural service.

Cows were synchronized using a single injection of prostaglandin and then mated naturally at UNL's Gudmundsen Sandhills Laboratory (*2009 Nebraska Beef Cattle Report*, pg 9). Cows were exposed to bulls beginning on day -5. On day 0, all cows were injected with prostaglandin and the breeding season continued for the next 45 to 60 days (*Figure 19*). Research indicates that females bred between days 0 and 5 have a CL that will not respond to prostaglandin. Bull-to-cow ratio was 1:25 and experienced bulls were used. This program significantly increased the percentage of cows calving during the first 21 days of the calving season.

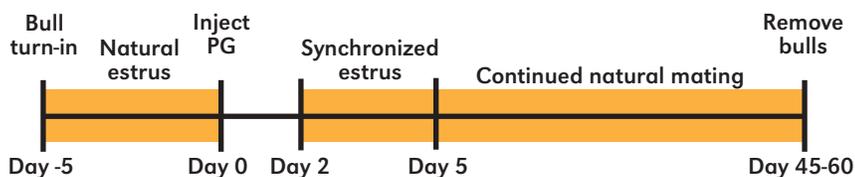


Figure 19. PG natural service.

When using natural service protocols, consider using mature bulls and a bull-to-female ratio of 1:15 to no more than 1:25. Make sure bulls have gone through a Breeding Soundness Evaluation. Observe closely for exhaustion and injuries during the synchronized breeding period. It may be necessary that bulls be rotated or replaced every 12 to 24 hours during the synchronization period.

## Conclusion

The cost of using a synchronization program in your cow herd will depend on many factors, including labor and facilities, products used in the different protocols, artificial insemination supplies, effectiveness of the protocol in synchronizing estrus or ovulation that results in a pregnancy, and the cost of clean-up bulls.

- 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.

- 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:

- females exhibiting estrous cycles for protocols that include only prostaglandin;
- healthy animals free from disease and on a good nutrition program;
- a willingness by producers to learn how to use the product(s) and program(s);
- a trained artificial insemination technician;
- a working facility with a small crowding corral, a holding alley and chute;
- providing and preparing for extra labor needs;
- accurate and thorough detection of estrus; and
- individual identification of females and accurate recordkeeping.

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