

# Synchronizing Estrus and Ovulation in Cows and Heifers

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As with other areas of livestock management, techniques for synchronizing estrus and ovulation are changing and improving at a greater rate than in the past. Those who failed to consider artificial insemination (AI) as a viable option in the past should review the new techniques and improved responses. Keeping up with those changes will allow producers to optimize their use of AI.

Ultrasound technology has increased our understanding of follicular growth and this information has been used to develop new synchronization methods and improve existing ones. An increased number of hormonal products are now available for use in synchronization.

A successful program to synchronize estrus and ovulation requires top management. Because individual producer goals and resources vary, no one method may be best for all situations. Methods vary in number of times cows must be handled, necessity of heat detection, tightness of synchrony, effectiveness of inducing fertile estrus and ovulation in non-cycling animals, and cost. The decision to use a particular protocol should be based on the goals of the individual AI program, the availability of time and labor, and estimated costs versus returns.

## What to expect from an AI program

Understanding terminology is important in developing realistic expectations for a synchronization program. Data commonly reported about synchronization methods include synchrony rate, conception rate and pregnancy rate. Each of these reveals something different about a particular response.

*Synchrony rate or heat detection rate* is the number of animals detected in heat in a defined period divided by the number treated. *Conception rate* is the number of pregnant animals divided by the number inseminated. *Pregnancy rate* is the number pregnant divided by the number synchronized.

Pregnancy rate reflects both synchrony rate and conception rate because it is the mathematical product of heat detection and conception rate. Pregnancy rate may be reported for a defined AI period or for the entire breeding season. Inseminations may be administered after detected estrus or by appointment after various hormonal injections (timed AI). Conception rates after timed AI are typically lower than when AI occurs following observed heat activity. However, because all females are inseminated in a timed AI protocol, the pregnancy rates may be similar between the two methods (Table 1).

Table 1. Pregnancy rates for AI protocols

	AI after estrus	Timed AI
No. Treated	100	100
No. Inseminated	87	100
Conception Rate	60%	52%
Pregnancy rate	52% <sup>a</sup>	52% <sup>b</sup>

<sup>a</sup>100 x .87 x .60 = 52%

<sup>b</sup>100 x 1 x .52 = 52%

Although each situation is different, producers who use a synchronization program should recognize that a pregnancy rate of 50 percent in a five- to seven-day period is a good response. Higher responses can be achieved but should not be expected every time or in all situations. Lower responses are not uncommon. When comparing responses to various treatments, be sure to compare pregnancy rates to pregnancy rates.

## Ensuring Success

### Cows

Anestrus is the period of time after calving before a cow resumes normal estrous cycles. Duration of anestrus is influenced by age, parity, calving difficulty, body condition score and suckling intensity. Estrous synchronization programs work best on females that are cycling, but realistically all cows in a herd will not be cycling at the beginning of the breeding season.

Data from more than 3,200 Kansas cows indicate that approximately 60 percent of cows are cycling at the start of the breeding season. A greater proportion of cows in body condition score of 5 to 6 will be cycling at the onset of the breeding season than cows with a body condition score less than 5. The percentage of cows cycling at the onset of the breeding season increases when more cows have calved earlier in the season. Replacement heifers that are bred to calve up to three weeks earlier than mature cows still have a lower proportion cycling at the start of the breeding season.

To help ensure a successful breeding program, mature cows should be in a body condition score of 5, and two-year-old cows in a body condition score of 6 at calving. Trying to increase body condition between calving and breeding is difficult, particularly in heavy milking cows. Cows will first put any additional energy they consume toward achieving their genetic potential for milk production before they will gain weight.

Research shows that it is best to strive to get cows to a body condition score of 5 or greater at calving. Females that calved late or are thin (body condition score of 4 or less) are not good candidates for synchronization. Young cows should be in excellent body condition and at least 60 days post-calving to respond well to synchronization programs.

### Heifers

Puberty in heifers depends on both age and weight, and varies with breed. So young, growthy heifer calves may be able to achieve acceptable body weights but still not reach puberty by the start of the breeding season because they are too young. Higher fertility will

be achieved if heifers have had two or more estrous cycles before the start of the breeding season.

Rations should be developed so heifers achieve 65 percent of their mature body weight by the onset of the breeding season. It is not cost effective to get heifers overly fat (body condition score of 7 or greater) and may reduce conception rates. When using a target weight, accurate knowledge of mature body weight is important. Mature cow size has increased over the years in most herds, so heifer target weights need to increase accordingly.

### Heat Detection

If females are to be bred after an observed heat, then the first potentially limiting factor in the system is heat detection. Checking heat twice daily for 30 minutes is a bare minimum for an unsynchronized group of animals and would be insufficient for a synchronized group of animals. Research in Colorado indicated that an intense heat detection system of two hours in the morning, two hours again in the evening and an hour at noon resulted in 40 percent more females found in heat in five days than checking twice daily for 30 minutes each.

When observing females for heat after a synchronization protocol, it is recommended that once a female has been observed standing solid, that she be pulled and placed in a "hot" pen. This may provide a better chance for more submissive females to be observed in heat and avoid missed heats. Another recommended technique is to move all animals to a corner of a pen or pasture during heat detection to increase opportunities for females to interact. In larger groups of animals with many animals in heat, a point is reached where known cows in heat must be sorted off in order to detect any new cows in heat. A variety of heat detection aids are available and can be useful in certain situations.

### Semen Quality

Semen quality varies among bulls. Before making final genetic selections, have your semen provider identify bulls of known high fertility especially for a timed insemination program.

### Details

Successful AI programs demand attention to details. Treatments need to be administered in a timely fashion using appropriate methods. Beef quality assurance guidelines should be followed when giving treatments. Semen handling from the time it is collected until it is deposited in the cow is important. Facilities that are easy on people and cattle will likely maximize conception rates.

# Methods of Estrous Synchronization

Methods of synchronization described below are based on products available in the fall of 2003. Methods described can use any of the listed commercially available products. Follow label directions for correct administration of products.

## Products

### Prostaglandin F<sub>2α</sub> (PGF)

- Estrumate® (Bayer)
- In-Synch® (Agri Labs)
- Lutalyse® (Pfizer Animal Health)
- ProstaMate® (Phoenix Scientific)
- Approximate cost is \$2 to 3 per dose
- Available from vets and vet supply companies

### Gonadotropin Releasing Hormone (GnRH)

- Cystorelin® (Merial)
- Factrel® (Fort Dodge)
- Fertagyl® (Intervet)
- OvaCyst (Phoenix Scientific)
- Approximate cost is \$3 to 5 per dose
- Available from vets and vet supply companies

### Melengesterol acetate

(MGA; Pfizer Animal Health)

- Orally active progestin, available from feed dealers
- Approximate cost is 50 cents per head for a 14-day treatment, plus cost of carrier

### Controlled Internal Drug Release

(CIDR; Pfizer Animal Health)

- Intravaginal progesterone insert
- Approximate cost is \$8 per insert
- Available from semen distributors and vet supply companies

## Protocols

### Single injection of PGF

Prostaglandin synchronizes estrus by regressing the corpus luteum (CL). It is effective in cattle that were in heat seven to 17 days prior to injection. Females that were in heat five to six days before injection generally do not respond to PGF. Heifers that have not reached puberty or cows that have not resumed normal estrous cycles after calving will not respond to PGF. Any of the three options described could be applied to replacement heifers or cows. The peak day of estrus will center on 72 hours after PGF.

#### Options (Figure 1)

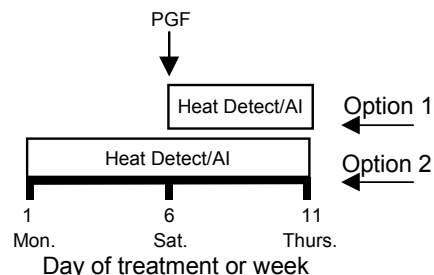
*Option 1.* Administer PGF and AI for five days. If all females are cycling, expect no more than 75 percent to show heat in two to five days.

*Option 2.* Heat detect and AI five days before PGF. Inject females not yet observed in heat and inseminated before day six and continue to AI through day 11. This method estimates how many females are cycling before administering PGF. If all cows are cycling, approximately 25 percent should show heat in the five days before PGF. If the proportion cycling is lower than expected, synchronization plans could be dropped or changed to a system that induces estrus in some non-cycling females.

*Option 2b.* PGF could be used any time after five or more days of regular daily heat checks and AI, to bring the AI period to an end. Inject any animal with PGF that was not previously observed in heat.

*Option 3.* PGF could be used as a follow-up treatment for females not detected in heat after the use of another synchronization protocol. Inject PGF 10 to 14 days after the majority of females were in heat. The treatment of PGF will be effective if females ovulated in response to a prior treatment but for whatever reason were not detected in heat (e.g., heat detection rate was low due to extreme weather conditions).

Figure 1. Single Injection of PGF



#### Advantages

- Low cost and minimal handling of animals.
- Consistently high conception rates.

#### Disadvantages

- Low heat detection rates and proportions of females cycling often limit pregnancy rates.
- Will not induce estrus in non-cycling females.
- Even if all females are cycling, it will not synchronize 100 percent of herd.

#### Best use

- For producers who want to shorten the AI period, but don't want or need to have a high proportion of females bred in one or two days.

## Double injection of PGF

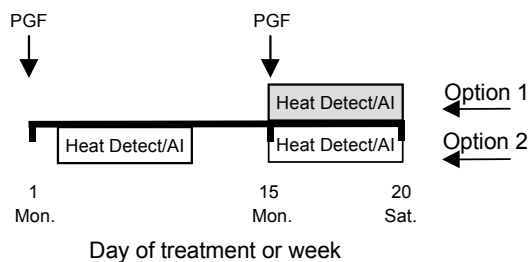
Using two injections of PGF will bring most females (if pubertal or cycling after calving) into heat two to five days after the second injection. Cattle that were not in the appropriate stage of the cycle to respond to the first injection should be in the appropriate stage at the time of the second injection. Tighter synchrony of estrus activity will occur after two injections of PGF than after one. Any of the options described could be applied to replacement heifers or cows.

### Options (Figure 2)

*Option 1.* Time between injections can range from 10 to 14 days, although best results are expected with 14 days between injections.

*Option 2.* Breed females that come into heat after the first injection. Only give the second injection to those that did not respond to the first one. The theoretical maximum number of animals responding to the first injection would be 75 percent. Actual proportion of animals responding would be reduced by any non-cycling females and limitations of heat detection.

Figure 2. Double injection of PGF



### Advantages

- Relatively low cost.
- Consistently high conception rates.

### Disadvantages

- Low heat detection rates and proportion of females cycling often limit pregnancy rates.
- Will not induce estrus in non-cycling females.
- Some animals do not respond to the second PGF injection.

### Best Use

- For situations where all females are cycling and tightness of synchrony is not a major concern.

## MGA + PGF

With this system, most females will show heat two to five days after the last day of feeding MGA. Do not AI females at this time because fertility is very low. By injecting females with PGF 19 days after the last day of MGA feeding, most will respond to PGF, and fertility will be normal. This is the most popular and successful protocol for heifers to date. The system can be used on cows, but its success over a wide range of production environments is not consistent.

For best results, cows should average 40 to 45 days postcalving at the start of MGA feeding. Because of the duration of treatment, late calving cows may not benefit from this treatment. Uniform consistent consumption of MGA is critical. To avoid consumption problems on grass, remove free-choice salt prior to starting MGA and include 1/2 oz. of salt per head per day in the MGA supplement. Peak estrous response in well-developed heifers can be expected about 60 hours after PGF.

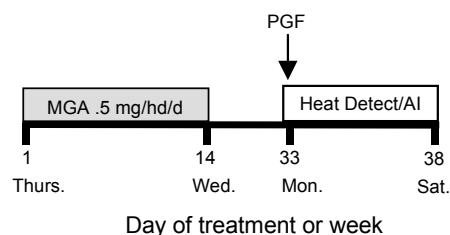
### Options (Figure 3)

*Option 1.* Wait 19 days between last feeding of MGA and PGF injection, heat detect and AI for 5 days.

*Option 2.* At 72 hours, mass inseminate heifers not previously observed in heat and inseminated. Expect conception rates in the mass inseminated group to be about 50 to 70 percent of that achieved in the heifers inseminated after detected estrus. If estrous response through 72 hours is low (less than 50 percent), mass insemination is not recommended.

*Option 3.* (MGA-Select) Inject GnRH seven days before PGF (Day 26 in illustrated protocol). The treatment does not seem to be warranted for well-developed beef heifers. This method should result in tighter synchrony in cows than the MGA + PGF alone, but may not be any better than Select Synch (see description in next section). A common approach is to AI using the AM-PM rule through 72 hours after PGF and mass inseminate those remaining at 72 to 80 hours. If estrous

Figure 3. MGA + PGF



response through 72 hours is low (less than 50 percent), clean-up timed insemination is not recommended.

*Option 4.* If schedule problems prevent a 19-day interval (best interval) between the last feeding of MGA and PGF, wait 17 (original system) to 18 days.

#### Advantages

- Induces estrus in some non-cycling females.
- Low cost and minimal handling.

#### Disadvantages

- Requires planning well in advance of the breeding season.
- Duration of treatment is lengthy.
- Uniform daily consumption of MGA may be hard to achieve.

#### Best Use

- Heifers developed in a feedlot setting where uniform consumption of MGA is easily achieved.
- MGA-Select has produced good AI pregnancy rates in cows where adequate MGA consumption can be achieved and the cow herd averages 45 days or greater between calving and the start of MGA feeding.

#### GnRH + PGF

This is a relatively new approach, and the simplest GnRH + PGF system is referred to as Select Synch. This protocol seems to work best for mature cows, whereas response in replacement heifers is variable. Many variations of this basic system are possible and we do not know what works best in all situations. As many as 10 to 20 percent of cows may show heat one to two days before PGF is administered. These cows should be bred according to the AM-PM rule because they would not be expected to conceive to a timed AI.

#### Options (Figure 4)

*Option 1.* AI after observed estrus using the AM-PM rule (Select Synch). This is the only GnRH system that should be considered for heifers.

#### *Option 2.* Timed AI

a. Time inseminate at 48 hours after PGF and give a second injection of GnRH at the time of AI (CO-Synch). Could be combined with 48-hour calf removal between PGF and AI.

b. Give a second injection of GnRH at 48 hours after PGF and then mass inseminate 16 to 18 hours later (Ovsynch). This option is used by

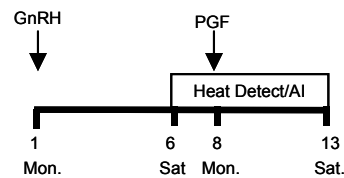
dairy producers. When CO-Synch and Ovsynch have been compared in beef cows, results are similar so the additional trip through the chute is probably not justified.

*Option 3.* Combine 1 and 2a, heat detect from one to two days before PGF to one to three days after PGF, and mass inseminate all cows not observed in heat at 48 to 72 hours after PGF in addition to giving a second injection of GnRH to cows at the timed insemination.

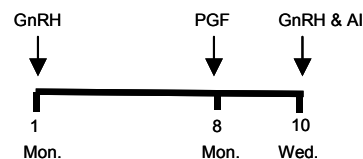
*Option 4.* Several progestins have been administered between GnRH and PGF on an experimental basis to prevent early heats. To use MGA, feed 0.5 mg per head per day from day two to day seven. To use a CIDR, insert on day one and remove on day eight. Pregnancy rates have improved from 0 to 15 percent by including a progestin. Include a progestin in situations where a high percentage of cows are thin and fewer are likely to be cycling. The optimum timing of insemination with this system is not known although one study showed similar pregnancy rates for timed AI at 48 or 60 hours after PGF.

Figure 4. GnRH + PGF

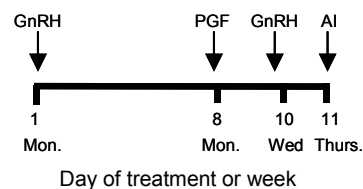
#### Select Synch



#### CoSynch



#### OvSynch



#### Advantages

- Induces estrus and ovulation in some non-cycling females.
- Enables timed AI in lactating cows.

## GnRH + PGF (continued)

### Disadvantages

- Variable responses have been observed using this method, especially in replacement heifers.
- Costs of drugs and animal handling is greater than some systems.
- Early heats are probable one to two days before PGF.

### Best Use

- For herds that cannot or choose not to detect heat. The best choice for inducing cycling activity in later-calving, younger, and thinner cows is to include a progestin (six-day feeding of MGA or the CIDR).

## CIDR + PGF

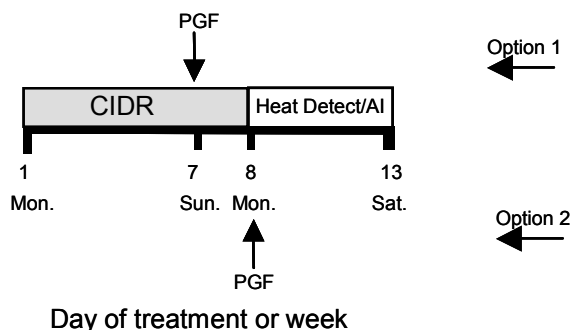
The EAZI-BREED CIDR (controlled internal drug release) insert is an intravaginal progesterone releasing device. The insert was approved for use in beef cows, and in dairy and beef heifers in 2002. The CIDR now has received approval for resynchronization of estrus in lactating dairy cows. While in place, the CIDR keeps females from coming into heat. The PGF regresses the CL so heat will occur after the CIDR is removed. The CIDR will induce estrus in some anestrus females. Attention to cleanliness is essential at insertion. Removal is fast and easy. Re-use of the CIDR is not recommended.

At press time, data from a large multi-state study (both cows and heifers) is being analyzed. We anticipate being able to improve the existing recommendations for CIDR use based on that study. Details from that study should be available in early 2004 at [www.oznet.ksu.edu/nwao/livestock.htm](http://www.oznet.ksu.edu/nwao/livestock.htm).

### Options (Figure 5)

*Option 1.* Inject PGF one day before insert removal. Expect tightest synchrony with this option.

Figure 5. CIDR + PGF



*Option 2.* Inject PGF on the same day as insert removal. Allows one less trip through the chute. Distribution of females in heat is more variable.

### Advantages

- Induces estrus and ovulation in some non-cycling females.
- Ensures a consistent delivery of progesterone.
- Produces tight synchrony of estrus.

### Disadvantages

- Cost can be higher, especially if combined with GnRH systems.

### Best Use

- For lactating cows in a CO-Synch + CIDR timed insemination system, timed AI at 54 to 60 hours after CIDR removal. CIDR use could be limited to those cows most likely to be anestrus; two-year-olds, thin cows, late calvers.

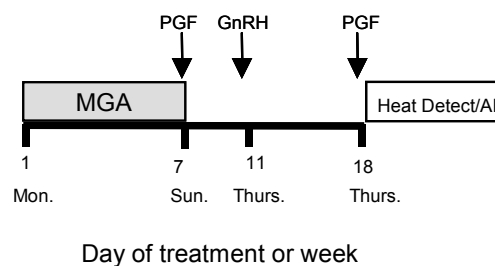
## MGA+PGF+GnRH+PGF (7-11 Synch)

This system was designed to shorten the length of the MGA feeding period without compromising fertility and to synchronize a wave of follicular growth just prior to induced estrus. Synchrony of estrus with this system seems to be very good with the peak estrous response at 42 to 66 hours after the last injection of PGF. In one study in lactating cows, timed AI at 60 hours after PGF produced acceptable pregnancy rates. Insufficient information is available comparing this system to others to determine if the results justify a fourth trip down the chute. (Figure 6)

### Advantages

- Tight synchrony of estrus. Good for synchronized recipients for embryo transfer.
- Early heats, as seen with CO-Synch or Select Synch, seem to be avoided.

Figure 6. MGA+PGF+GnRH+PGF



### Disadvantages

- Complex system that requires considerable animal handling.

### Best Use

- Jury is still out, may be for strict timed AI when animal handling is very easy.

### Results

AI pregnancy rates will vary widely for the same synchronization system applied under different conditions. Table 2 depicts ranges in pregnancy rates that might be expected during a 5-day AI period or a single timed AI (CO-Synch and Ovsynch). The value under the “typical” column is a conservative estimate that might be used for planning in well-managed herds in optimum condition.

### Summary

Rumors of other treatments are common because of ongoing research. Some involve an additional step(s) or products that are not commercially available in the United States. Further research is needed before such treatments can be

widely recommended. The methods described are relatively simple and will yield good results when used according to the protocol.

A synchronization planner spreadsheet can be found at: [www.iowabeefcenter.org/content/TOOLS.htm](http://www.iowabeefcenter.org/content/TOOLS.htm). This spreadsheet produces a calendar that shows when treatments should be administered based on your choice of systems and starting breeding date.

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Table 2. Pregnancy rates (%) to a 5-day AI period or a single timed insemination\*

	Heifers		Cows	
	Range	Typical	Range	Typical
<b>MGA/PGF</b>	40-70	60	40-60	55
<b>MGA-Select</b>	40-65	60	40-65	60
<b>MGA CO-Synch*</b>			45-65	60
<b>Select Synch</b>	40-65	50	25-55	45
<b>CO-Synch*</b>	--		30-55	50
<b>CO-Synch+CIDR*</b>	--		+0-15	
<b>Ovsynch*</b>	--		50-57	50
<b>CIDR+PGF</b>	35-60	45	35-60	45
<b>7-11 Synch</b>	30-55		35-65	
<b>2xPGF</b>	30-65	50	20-45	40

\*Single timed AI

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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