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Synchronization Programs Update

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Introduction

Synchronization of estrus involves methods of manipulating the estrous cycle of females within a herd so they express estrus at approximately the same time. There are several traditional protocols available for synchronizing estrus (heat) among beef cows. Traditional protocols include one or two Prostaglandin protocols, the MGA/prostaglandin protocol and the Syncro-Mate B protocol. None of these methods have been universally adopted because none are able to satisfy all situations. There are also a couple of new protocols that have been developed within the last 2 years that have resulted in higher success than traditional protocols. These new protocols include the use of prostaglandin and GnRH (Gonadotropin Releasing Hormone). The intent of this article is to familiarize the reader with estrous synchronization, review the traditional protocols that are available, and introduce the new protocols for synchronization of estrus.

Estrous synchronization is a useful part of an artificial insemination program because checking for estrus in breeding animals, particularly under range conditions, is time consuming and expensive. Synchronization of estrus allows a producer to schedule labor for the appropriate time during the breeding and calving seasons. Synchronization 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 subsequent breeding season and thus, are more likely to be exhibiting estrous cycles (cycling) at the start of breeding. Increasing the number of cows cycling at the onset of breeding may translate to higher pregnancy rates and lower heifer replacement rates. The net results of an estrous synchronization program should provide an economic edge to the cow/calf producer by improving herd quality, calf crop uniformity and potentially lower annual production costs.

The success of the estrous synchronization program could depend upon a producer's understanding of how it works. Success may also depend upon the number of cows that are cycling when the protocol is initiated. Within any herd of cows, some of the cows will generally be anestrus at the start of the estrous synchronization treatment. Unless the proper estrous synchronization protocol is chosen, these cows have no chance of responding. The ability of individual estrous synchronization protocols to induce estrous cycles in anestrous cows is mentioned below. Regardless of the estrous synchronization protocol chosen, cows should be at least 30- 40 days since calving at the initiation of treatment.

Understanding the Estrous Cycle

A review of the estrous cycle in a cow (normally, a 2l-day period; Figure 1) might be helpful. On day 0 or 21 of the estrous cycle, the female is in heat, and one of her ovaries has a blister-like structure called a follicle that contains a mature egg. This follicle is producing high

levels of estrogen that cause the cow to display behavioral signs of heat. On day 1, approximately 28 hours after the onset of heat, the dominant follicle ruptures. The egg is released and enters the oviduct, where fertilization may occur. The fertilized (embryo) or unfertilized egg will travel through the oviduct to the uterus, where it may implant and develop into a calf. With the release of the egg from the ovary, cells of the ruptured follicle transform (luteinize) and become luteal cells which grow and divide over the next 5 days, filling the follicular cavity on the ovary to form a structure called the CL (corpus luteum). The CL produces progesterone, which prepares the uterus for pregnancy and is necessary to maintain the pregnancy. Note that progesterone levels gradually rise from day 1 to 5 (Figure 1). Progesterone also blocks the release of hormones (including GnRH, luteinizing hormone (LH) and follicle stimulating hormone (FSH)) that allow final maturation of new follicles on the ovaries. If an embryo is not present in the uterus on day 17 of the estrous cycle, the uterus produces a hormone called prostaglandin, which destroys the CL, decreasing progesterone levels. Low progesterone levels allow GnRH, FSH & LH to increase, and stimulate follicles on the ovaries to develop and mature. One follicle becomes dominant and will eventually ovulate while the others begin to die. The dominant follicle produces estrogen, resulting in the reoccurrence of estrus (day 21).

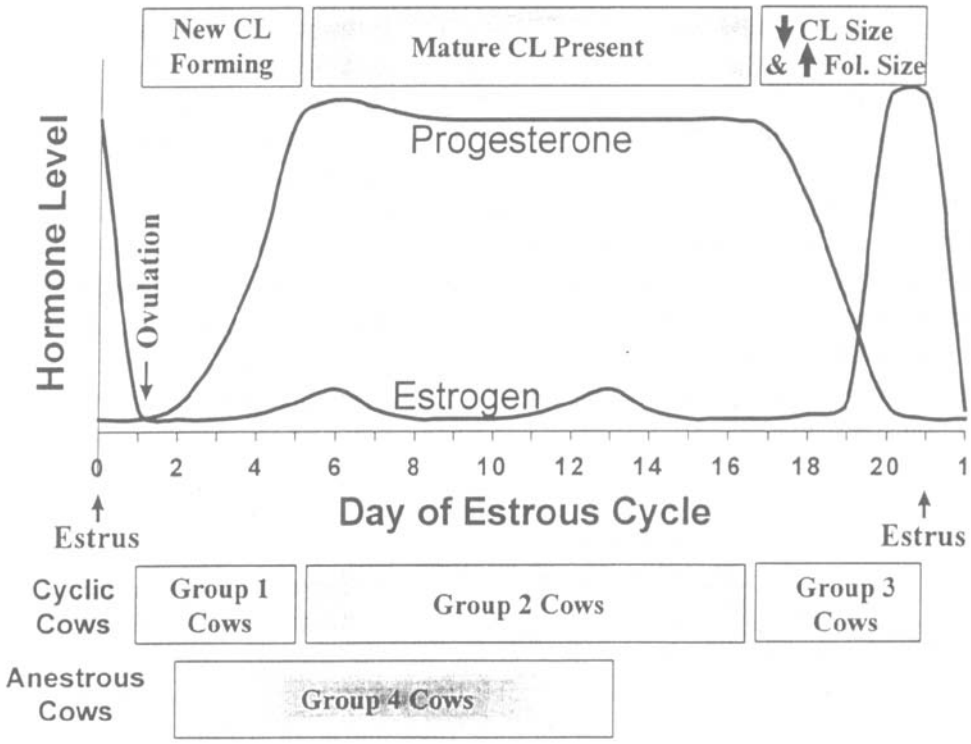

Figure 1. Illustration of the estrous cycle of a cow and groups of cows(based on response to synchronization) within a herd.

In a herd of non-pregnant cattle, cows will be at various days of their estrous cycles or anestrus (not cycling). Under normal conditions, approximately 5 percent of the cyclic cows will be in heat on any given day. Cyclic cows may be grouped into one of three categories for their

response to synchronization (Figure 1). Because the CL is present from day 6 of the estrous cycle until day 17 or 18, approximately 60% of cows that are cycling will have a CL on their ovaries at any one time (group 2). The remainder will be developing new CL's (group 1; days 1 - 5) or regressing old CL's (group 3; days 18 - 21). The final group of cows within a herd would include anestrous cows (group 4). Estrous synchronization products are designed to bring all the females within a herd into heat at approximately the same time.

Estrous Synchronization Protocols

Synchronization of estrus became feasible in commercial herds when prostaglandins became available. Prostaglandins regulate a female's estrous cycle by causing "luteolysis" or regression of the CL An injection of a synthetic prostaglandin (commercial names: Bovilene, Estrumate, or Lutalyse) will mimic natural prostaglandin release and will cause CL regression. Prostaglandin eliminates the progesterone block to allow increased follicular growth and estrogen production. Cows with a CL on their ovaries when they receive an injection of prostaglandin will usually exhibit heat 2 to 5 days later. Thus, cows must be in a certain phase of the estrous cycle before prostaglandins will work (group 2; Figure 1). Prostaglandins will not affect an immature CL (group 1 cows; Figure 1) nor will they affect cows after the CL has already started to regress (group 3 cows; Figure 1). However, cows that are between day 17-20 of their estrous cycle are coming into heat over the next 1-4 days anyway, so an injection of prostaglandin makes these cows appear to respond to the injection. In the average herd, it is estimated that less than 80% of cows are cycling at the onset of the breeding season. Animals that are not cycling (group 4 cows) will not respond to an injection of prostaglandin.

If prostaglandin products are to be used to synchronize estrus, it is necessary to manipulate estrous cycles so that the majority of cows will have a mature CL, that is susceptible to regression by prostaglandin. There are four prostaglandin programs being used to synchronize estrus in cattle. Two of these programs require two injections of prostaglandin and two require just one injection.

One Injection of Prostaglandin with Breeding after the Injection

Inject all cows and check heat and breed all cows 12 hours after standing heat (Figure 2). With a single injection of prostaglandin, ~75% of the cycling cows would be expected to display heat (group 2 and 3 cows) during the next 4 - 5 days. Because most herds include some anestrous cows, the actual percent of cows that exhibit heat will be somewhat less.

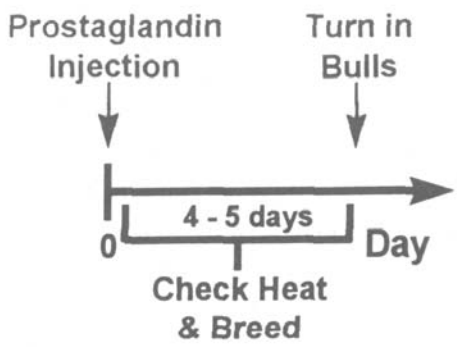

Figure 2. One injection prostaglandin protocol with breeding after the injection.

Two Injection Prostaglandin Programs (Figure 3)

The two injection programs for synchronization with prostaglandin allow breeding after each prostaglandin injection (program 1) or only after the second injection (program 2). An injection of prostaglandin (Bovilene, Estrumate, or Lutalyse) is given to all cows. After one injection, ~ 75 % of the cycling females should be in heat during the next 5 days. Females that are detected in heat can be bred 12 hours after being detected in standing heat (program 1, Figure 3). The animals that are not detected in heat and bred after the first injection should receive a second prostaglandin injection 11-14 days later and be bred 12 hours after they display standing heat (program 2, Figure 3). When breeding cows after each injection, be sure not to give prostaglandin to cows that have already been breed. Traditionally, the second injection of prostaglandin was administered at 11 days following the first injection. However, recent data suggests that administering the second injection 14 days after the first injection yields a greater response. Two injections should theoretically synchronize estrus in most cycling cows within 2 to 5 days after the second injection. For some reason, however, a small percentage of cows that display heat after the first injection, fail to display heat after the second injection. Synchronization responses of 70-80% of cows within a herd are common with this protocol, but are highly variable depending on the number of anestrous cows in the herd. Timed insemination with this protocol is too risky and is not recommended.

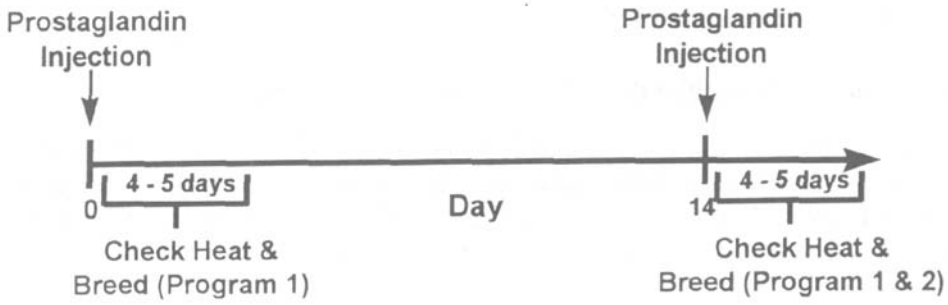

Figure 3. Two injection prostaglandin protocols with breeding after each injection (program 1 only) or only after the second injection (program 2).

One Injection with 10 Days of Breeding

Heat check and breed all cows in standing heat for the first five days of the breeding season. Inject all cows not previously bred at the end of day 5 and breed 12 hours after standing heat (Figure 4). By breeding for 5 days, none of the cows that receive the prostaglandin injection will be between day 1-5 of their estrous cycle. Thus, all cows that are cycling should display estrus within 5 days after the prostaglandin injection. This is the most popular protocol that uses only prostaglandin to synchronize estrus, and can result in greater than 90% of cyclic cows being bred during the first 10 days of the breeding season.

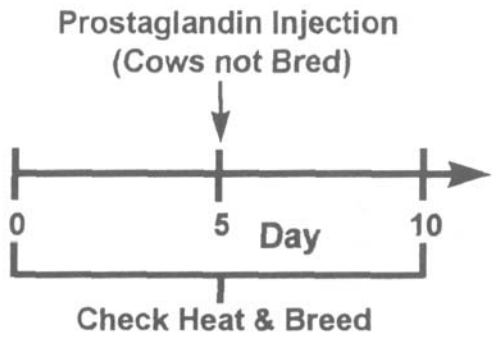

Figure 4. One injection prostaglandin protocol with 10 days of breeding.

MGA/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 and is widely used in feedlot heifers. In this estrous synchronization procedure, MGA is fed at .5 mg/head/day for 14 days. Feeding MGA for 14 days allows cyclic cows to proceed to day 18-19 of their cycle on their own, but holds them at that stage until the MGA is removed from their feed. Group 2 and 3 females and some group 4 females (Figure 1) will exhibit estrus 2 to 5 days after withdrawal of the MGA. This is a **subfertile** heat and females should not be bred. 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 withdrawn will regress the CL of the next estrous cycle. Most females will show estrus 48 to 72 hours after this prostaglandin injection. Cows should be bred 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 acceptable pregnancy rates. Care must be taken with this protocol to make sure all females consume MGA daily during its feeding. This method is used in heifers more than cows because it takes 31 days to administer and most cows would not have calved early enough to receive this treatment.

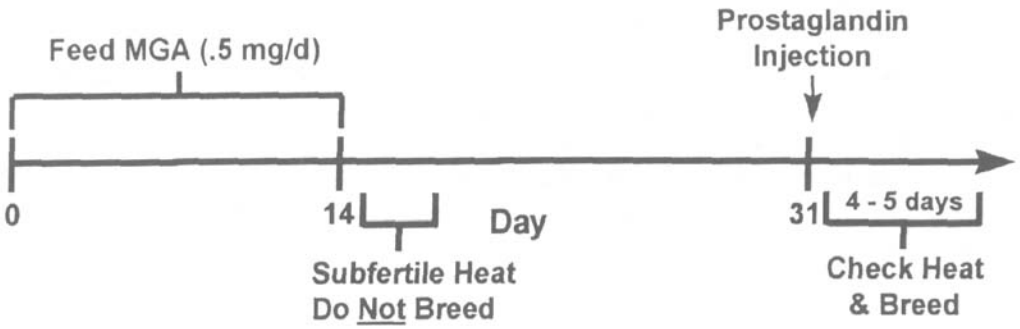

Figure 5. MGA / prostaglandin protocol that was developed primarily for heifers.

Syncro-Mate B Program

Estrous synchronization using Syncro-Mate B consists of administering an injection and an ear implant on day 0 that is removed on day 9 (Figure 6). After removing the implant, cows are observed for standing heat and bred 12 hours later or time inseminated at 48 -54 hours after implant removal. The ear implant contains norgestomet (a progesterone-like compound) and is placed subcutaneously on the backside of the ear. Before inserting the implant, it is helpful to clip the hair on the back of the ear, and disinfected the implant site. The implant contains a synthetic form of progesterone called norgestomet. 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 remains in the blood for about 5 days and causes regression of the mature CL's and any new CL's that mature during these 5 days. Together, the estradiol valerate and norgestomet cause luteolysis and advance all cows to approximately day 19 of their estrous cycle and hold them there until the implant is removed. On day 9, when the norgestomet implant (progesterone 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 5 days. Syncro-Mate B also induces estrous cycles in some anestrous cows. Thus, cows in groups 1 - 4 respond fairly well to Syncro-Mate B. One word of caution however; there is data that suggests cows in thin body condition may not respond well to Syncro-Mate B.

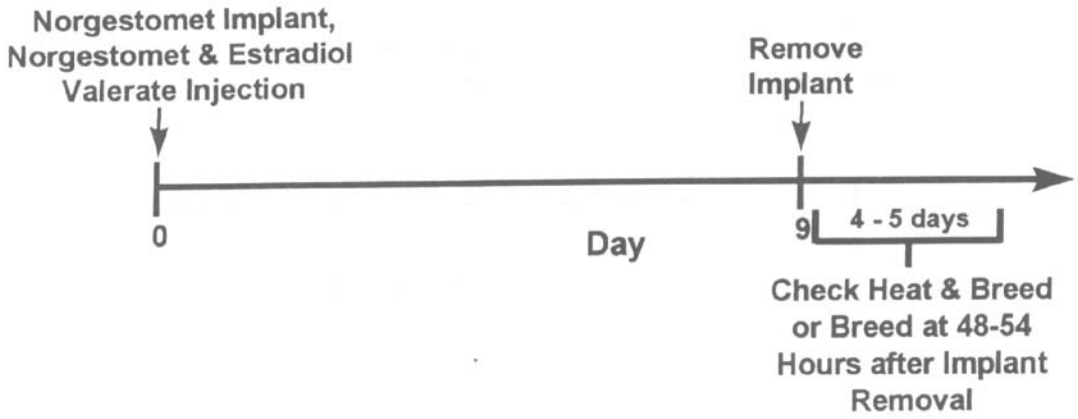

Figure 6. Syncro-Mate B protocol with breeding by detecting heat or breeding at a predetermined time regardless of estrus.

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

1. All animals are mass inseminated at a predetermined time. Cows should be inseminated between 48 and 54 hours after implant removal without regard to time of heat.
2. Animals are inseminated 12 hours after first observation of standing heat. This results in better 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 cows that show estrus before 48 hours by the am-pm rule and mass mate non-responding cows at 48-54 hours after implant removal. Mass mating at this time can result in pregnancy in about 30 percent of non-responding animals.

GnRH/Prostaglandin (Select Synch) Protocol

A new method for synchronizing estrus in beef cows is to administer a GnRH injection followed one week later by an injection of prostaglandin (Figure 7). All animals are observed for signs of estrus for 5 days following the prostaglandin injection and inseminated 12 hours after standing estrus is observed. This protocol has also been 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 will initiate estrous cycles in some anestrous cows. Thus, most group 1 - 4 cows (Figure 1) will respond to this protocol. Some cows (~8 %) will exhibit estrus up to 36 hours before the prostaglandin injection, but the peak estrous response will be 2-3 days after the prostaglandin injection. These early heats are fertile heats and cows should be bred 12 hours later. The prostaglandin injection is not necessary in cows that have already exhibited estrus, but will not cause any harm, either. Timed insemination is not recommended for 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 yet cycling.

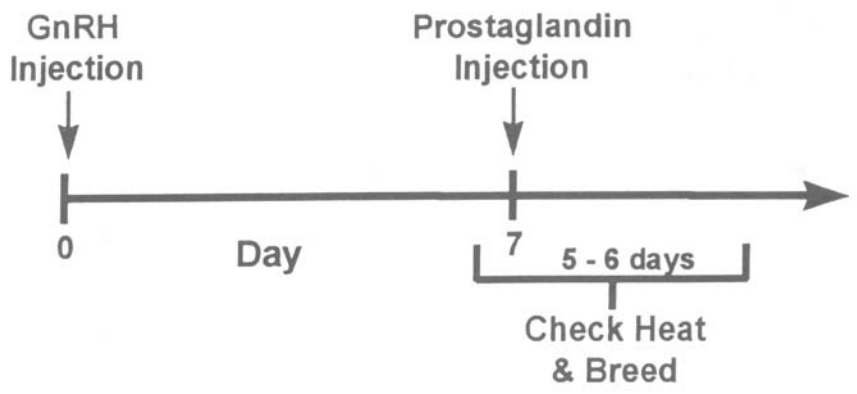

Figure 7. Select Synch protocol with breeding by detecting heat.

A slight variation to the Select Synch protocol involves administering the GnRH injection on day 0, prostaglandin on day 7, and a second GnRH injection 48 hours after the prostaglandin injection coupled with mass mating (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 yields pregnancy rates similar to breeding after detecting estrus. Higher pregnancy rates might be obtained by breeding cows that show estrus prior to day 9 and mass mating remaining cows on day 9 with the second injection of GnRH. The 48 hour time period may be critical, as waiting until day 10 to give the second GnRH injection coupled with mass mating results in poor pregnancy rates.

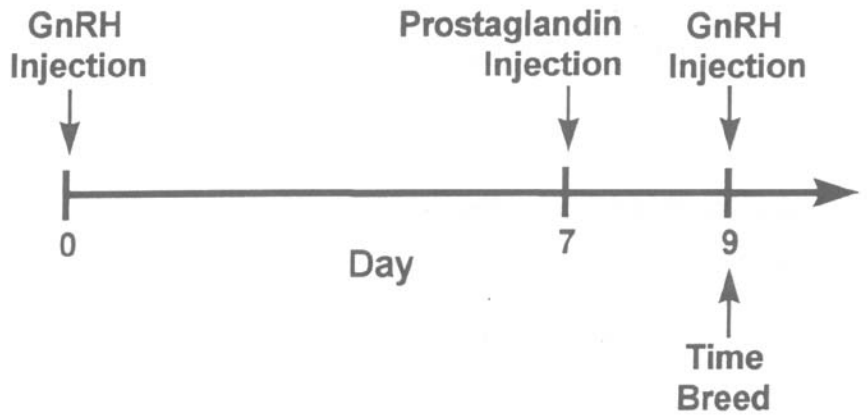

Figure 8. CO-Synch protocol with timed breeding at 48 hours following the prostaglandin injection.

General Considerations

For any estrous synchronization program to be successful, a high percentage of the

females need to be exhibiting estrous cycles before the breeding season begins. An estrous synchronization program will not enhance overall pregnancy rates, increase conception, nor improve reproductive performance in noncycling or subfertile cattle, particularly when poor management is responsible for the condition of the cattle. The MGA/Prostaglandin, Syncro- Mate B, Select Synch, and CO-Synch protocols are probably only capable of inducing estrous cycles in cows that are close to starting to cycle on their own.

There is some evidence that 48 hour calf removal with the Syncro-Mate B protocol (initiated at the time of implant removal) results in higher pregnancy rates. Preliminary data from our laboratory using 48 hour calf removal with the CO-Synch protocol (from the time of prostaglandin injection until the 2nd GnRH injection and mass mating) has also revealed a 10 % increase in pregnancy rates. Calf removal for 48 hours has no detrimental effects on overall calf performance as long as calves are provided a clean environment with clean water and good quality grass hay during the time they are separated. Calf removal may actually facilitate cattle handling, because it prevents the need to sort off pairs when the cows is in heat and prevents sorting calves again for mass mating.

A successful program requires: (1) normally cycling cattle that are individually identified; (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 and program; (4) availability of a qualified inseminator; (5) high quality semen; (6) a working facility with a small crowding corral, a holding alley, and a breeding chute; (7) accurate and thorough detection of estrus; and (8) accurate record keeping.

Heat Detection

Poor heat detection is often the cause of poor responses to synchronization. It is vitally important to an estrous synchronization program to observe cows closely during the synchronized period. Cows should be observed for a minimum of one hour in the early morning, around mid-day, and in the late evening. Stormy weather is known for suppressing estrous activity, so it is even more important to spend additional time with cows during these times. Heat detection pastures should have enough grass and water to support cattle during the time of detection and breeding. The size of the holding pastures is determined by the size of the herd, but pastures should not be so large that animals cannot be readily observed. It is beneficial to remove cows that are in estrus from the rest of the herd as soon as they are detected in estrus because it allows submissive cows to be detected in estrus more easily.

Will It Pay to Synchronize Estrus?

A single dose of prostaglandin, GnRH and Syncro-Mate cost about $2.50, $3.50, and $6.00, respectively. Thus, the cost of the two injection prostaglandin protocol, Select Synch, and CO-Synch systems are about $5.00, $6.00, and $9.50, respectively. Added to these costs are the expenditures for semen, the inseminator, and labor required to make the program run successfully. In most estrous synchronization programs, cattle go through a chute three times, including breeding Therefore, the producer needs to determine what the actual costs will be before a program is initiated. A comparison of estrous synchronization programs using AI is listed in

Table 1. These costs are based on the estimated pregnancy rates shown in the first column. Lower pregnancy rates than those listed will increase the cost per pregnancy. Depending upon the program, AI or cleanup bulls are desirable to achieve conception rates of 90 percent or better during the breeding season.

One thing that every producer should realize is that an estrous synchronization and breeding program is like a chain. It is only as good as its weakest link. Thus it is important to pay attention to all aspects of the program. It is evident that good management often makes the difference between success and failure.

Table 1. Comparison of estrous synchronization programs using AI.

Program	Estimated Synchronized Pregnancy Rate (%)*	Estimated Cost/Pregnant Female ($)
Prostaglandin:		
One injection of prostaglandin (10-day breeding)	50	34
One injection of prostaglandin with heat detection	37	36
Two injections with breeding after each injection	50	37
Two injections with breeding after the 2nd injection	50	39
Syncro-mate B:		
With heat detection	55	41
Without heat detection (mass AI)	50	47
MGA/Prostaglandin:		
With heat detection	55	35
Without heat detection (mass AI)	55	36
Select Synch:	55	37
CO-Synch (mass AI):	50	53
with calf removal	60**	44

* Pregnancy rate is 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.

** Preliminary data in 2 herds revealed that 48 hour calf removal (from prostaglandin injection until the 2nd GnRH injection) can increase pregnancy rates 10 %.