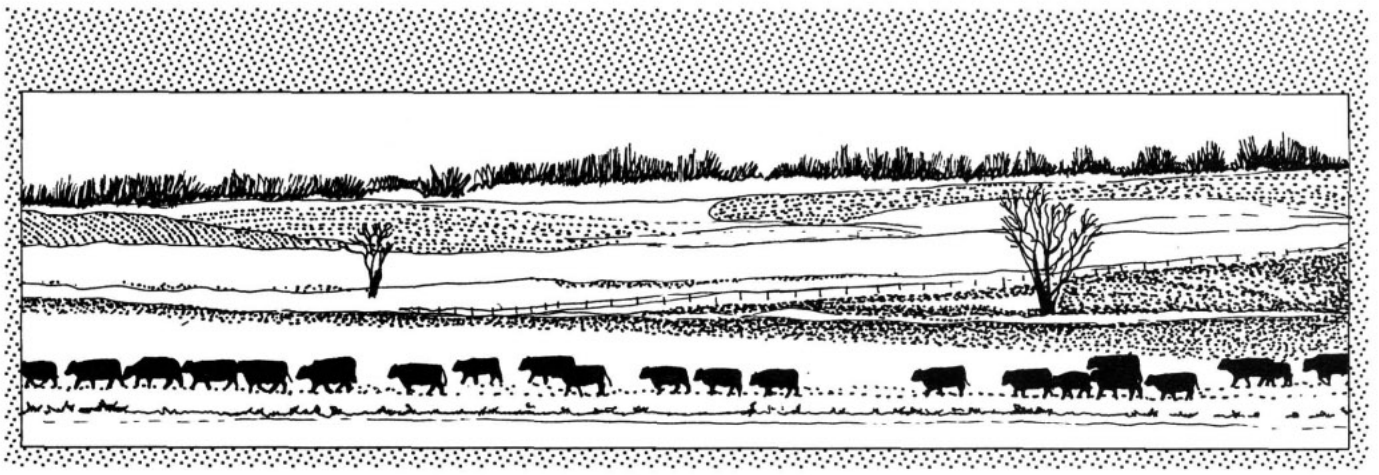

Present Status of Heat Synchronization in Beef Cattle

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The hormonal treatment of cows and heifers to group their estrus periods (heat) has been a commercial reality for about 10 years. Presently there are three general approaches to heat synchronization which involve the use of either: 1) prostaglandins, 2) Syncro-Mate B or 3) a combination of a progesterone-like hormone (e.g. melengestrol acetate - MGA) plus a prostaglandin. Recent surveys show that less than five percent of the beef cows in the United States are bred by artificial insemination (AI) and only half of the cattlemen that practice AI ever use any type of heat synchronization. Natural mating can be used after heat synchronization but that practice has been minimal. Therefore, the market penetration with heat synchronization products in beef cattle has been small.

Although the percentage of cattle producers using heat synchronization products has been small, heat synchronization has become a vital part of the breeding management practices of many producers. Producers considering using these products should be aware of several facts:

1. None of the synchronization procedures increase conception rates.
2. Generally, heat synchronization products are not effective in non-cycling females.
3. In no case does heat synchronization substitute for lack of nutrition, herd health, or proper management. Problems are just concentrated, not eliminated.

One could make a long list of advantages for heat synchronization, but most advantages have a comparable disadvantage. Most advantages relate to: 1) adjusting the cycles of cycling cattle so that they conceive earlier in the breeding period; 2) shortening the length of time necessary to breed a herd artificially; 3) making artificial insemination practical when it might not be otherwise, and 4) placing a cow or cows in heat at a predicted time to allow artificial insemination, embryo transfer, or other planned reproductive techniques.

Prostaglandins

Prostaglandin, a naturally occurring hormone, was approved for use in beef cattle in 1979. Prostaglandin (PGF2*a*) is a natural hormone produced by the uterus that terminates the normal cycle when a cow is not pregnant. This allows the cow to return to heat, ovulate and a new cycle is started. By injecting PGF2*a* or one of its analogues, the natural cycle can be interrupted allowing heat periods to be synchronized.

Prostaglandins that are approved for heat synchronization use in beef cattle by the Food and Drug Administration (FDA) and their trade names are PGF2*a* (Lutalyse), cloprostenol (Estrumate), and fenprostalene (Bovilene). Various other analogues of PGF2*a* are currently being investigated and may be near FDA approval.

Prostaglandins will synchronize heat only if cows are cycling and they are not effective on all days of the cycle. Prostaglandins work by regressing the *corpus luteum,* thus stopping production of the hormone progesterone. Progesterone normally keeps the cow out of heat so prostaglandins do not cause heat but simply stop progesterone secretion so the cow can start a new cycle. Prostaglandins have no affect if injected on days 0 through 4 of the cycle (day of heat = day 0). Cows injected on Days 0 through 4 have normal-length estrous cycles. There is a tendency for the prosta-glandin to be more effective in regressing the *corpus luteum* after Day 10 of the cycle than on Days 5 through 10.

In general, prostaglandins have been about 90 percent effective in regressing *corpora lutea* in cows between Days 5 and 17 of the cycle. Most failures occur in cows less than 11 days into the cycle. Estimates of successful synchronization of heat within five days after treatment in cattle known to be cyclic and between Days 4 and 18 of the cycle at treatment have been between 73 percent and 93 percent. Failure rate has been equally divided between cattle in which 1) the *corpus luteum* did not regress, 2) the *corpus luteum* regressed prematurely but not quickly enough to allow heat to occur

within five days after treatment, or 3) the *corpus luteum* regressed but heat was detected. Fertility associated with synchronized estrus has usually been equal to that of unsynchronized heat.

Field trials using prostaglandins in cattle with unknown cycling statuses have resulted in pregnancy rates ranging from 30 percent to 70 percent. The primary factor contributing to this variation is the percentage of cows cycling at the time of treatment.

In a typical beef-cow herd managed with a good nutritional program and a 90-day breeding period, a maximum of 80 percent of the herd should be expected to be cycling at the start of the breeding period. With 85 percent success of synchronization, 68 percent of the cows in the herd should show synchronized estrus. A 60 percent first-service conception rate would allow about 41 percent of the cows to conceive at the synchronized estrus. This figure is about average, based on the research data available. If the producer regards this rate of response as a failure, then synchronization should not be attempted for the entire herd given the above considerations. Forty-one percent of the herd having conceived during the first few days of the breeding period could be a financial success in terms of calves born earlier, more calves (from artificial insemination), and the need for fewer cleanup bulls.

To obtain a higher degree of success, cows should be selected for synchronization. Cows that are not good candidates for synchronization are: 1) those that have calved in the previous 40 days, 2) those with body condition scores that are lower than average (under five on a one-to-nine scale), and 3) those that have experienced calving problems. Also, heifers with poor body condition or weighing less than 60 percent of their expected mature weight are likely to be prepuberal. If a person who is proficient at palpation is available, rectally palpating a *corpus luteum* is a positive indication of ovulation and detection of a small reproductive tract with inactive ovaries indicates a poor synchronization risk.

Management Systems

Various degrees of synchronization can be achieved with different systems as well as different costs and labor requirements.

Four basic prostaglandin programs have been used to synchronize heat:

- Conventional artificial insemination for six days and, on the sixth day, injection of cattle that have not been inseminated.
- A single injection at the start of breeding period.
- Two injections 11 or 12 days apart and insemination only after the second injection.
- One injection, then insemination of all cows in heat for six to 12 days. A second injection can be given to cows that have not been inseminated at any time from six to 12 days after the first injection

Obviously, the first program listed involves the least synchronization cost and has probably been used most frequently by producers who want to decrease the length of the artificial breeding period. Except for cows that have their first heat between 10 and 21 days into the breeding period, the same number of cows should be inseminated in 10 days that would be inseminated in 21 days without synchronization. The five days of conventional artificial insemination before injecting a prostaglandin allows time to determine if enough cows are cycling to warrant injecting the herd. If 20 percent to 25 percent of the cows have been in estrus in five days, then most of the herd must by cycling. Less than 20 percent estrus may mean that the herd is a poor synchronization risk. Success of this procedure can be enhanced by waiting longer than six days (e.g., until Day 8 or 9) to inject the prostaglandin; however, waiting also lengthens the insemination period.

The second program involving one injection, has also been popular with producers who simply want to increase the number of cows inseminated early in the breeding period or want a short insemination period and are not necessarily interested in artificially inseminating all cows in the herd. With this program, a maximum of 75 percent of the cycling cows can be expected to exhibit heat within five days after injection.

The third program, which involves two injections 11 or 12 days apart, is the only system of prostaglandin synchronization that has the capability of synchronizing all cycling cows to a five-day period. An expected distribution for the onset of heat after treatment of cycling heifers with two injections of prostaglandin 12 days apart would be: Day 1, none; Day 2, 20 percent; Day 3, 45 percent; Day 4, 20 percent; Day 5, 5 percent; and 10 percent late or no response. 11 or 12 days is the recommended interval between the two injections, but intervals from nine to 14 days can be successful. Shorter intervals tend to produce less successful results because of the cycle day on which injections fall.

In general, inseminations at an appointed time after the second injection (a period of 72 or 80 hours is usually recommended) have not been as successful as inseminating according to estrus detection. Conception rates when breeding by heat detection have been equal to those

obtained in unsynchronized cows. The limited success of inseminating by appointment has been attributed to variation in the time to the onset of estrus after injection. Stage of cycle at injection, nursing versus dry status, environment, and the influence of other cattle appear to be the main factors affecting onset of estrus after injection. Data are unclear as to the success of timed inseminations versus breeding by heat detection because success with the latter depends totally on the accuracy in detecting heat. Slight increases in conception rate have occurred when cows were inseminated twice (e.g. 72 and 96 hours after the second injection). Double insemination has not been cost effective except when labor and semen costs are very low.

The fourth program listed has probably been used least. In that program, cows receiving a second injection could also be inseminated by appointment. Because all noncycling cows would be in this group, however, timed insemination would probably not be cost-effective.

Occasions may arise when the producer wants to use natural breeding for synchronized cows. Although such a decision reduces many of the advantages attributed to synchronization, certain circumstances may warrant this approach. It has been reported that some bulls can effectively breed 25 to 35 synchronized cows; however, the sexual behavior of bulls varies tremendously, particularly if a bull has never encountered more than one or two cows in heat at a time. Close observation is a must, and hand breeding may be necessary. The producer should be prepared to remove from the group cows that have been bred. Natural mating of synchronized cows does work, but precautions must be taken to ensure that all cows in heat are mated.

Syncro-Mate B

The Syncro-Mate B synchronization procedure involves placing a norgestomet implant under the skin in a cow's ear for nine days and injecting three mg of norgestomet in combination with five mg of estradiol valerate intramuscularly at the time the implant is inserted. The implant is removed nine days later. Cows can be inseminated by estrus detection or by appointment 46 to 52 hours after implant removal. In the Syncro-Mate B procedure, the combined injectable norgestomet and estradiol valerate serve to regress the *corpus luteum* and stop progesterone secretion. Unlike prostaglandins, however, Syncro-Mate B is effective during the time the *corpus luteum* is developing. Because the norgestomet implant suppresses heat and ovulation, cattle do not exhibit heat until the implant is removed. Depending on the stage of the cycle at implanting, the *corpus luteum* is regressed either by the injection or naturally by prostaglandin from the uterus. The Syncro-Mate B treatment requires catching the head of the animal twice to insert and remove the implant. This additional labor has limited the use of the procedure where facilities are inadequate.

One advantage of Syncro-Mate B over prostaglandins for synchronization is that the former has the capability of inducing heat in some non-cycling animals. Fertility at induced heat in previously non-cycling animals has been extremely variable. In prepuberal heifers that were given Syncro-Mate B, conception rates have been 20 percent to 60 percent. It appears that cattle in the transitional period between non-cycling and cycling, when induced into heat with Syncro-Mate B, conceive normally. If they are more than two to three weeks from cycling, response is poor. No data exist to support this, however. The same variation exists in postpartum anestrous cows. Generally, at Kansas State University we have had about 20 percent conception in non-cycling cows given Syncro-Mate B between 30 and 70 days after calving. The expected interval to normal cycling not only affects conception rate but the probability that the cow or heifer will continue to cycle. About half of the non-cycling cows that show estrus and do not conceive after being given Syncro-Mate B continue to cycle, but in prepuberal heifers the percentage may be higher.

Conception rates in cycling animals that are given Syncro-Mate B have also been variable, and little information is available to identify the factors contributing to the variability. In our experience, highest and lowest conception rates have occurred following synchronization with Syncro-Mate B. Most data indicate that conception rates are the same in cycling animals given Syncro-Mate B as they are in unsynchronized animals. In other experiments a depression in conception rates was noted. First-service conception rates in field trials where the cyclic status was unknown have ranged from about 30 percent to 60 percent. The Syncro-Mate B treatment produces closer synchrony of estrus than do prostaglandis and lends itself to timed insemination

programs. Timed inseminations should take place about 48 hours after an implant is removed. Conception rates have been similar in cattle that were inseminated either by heat detection or by appointment after being given Syncro-Mate B.

Although results may depend on how many cows are cycling at treatment, some trials showed about 46 percent of the cows conceiving on insemination at heat and 40 percent by appointment at 48 hours after implant removal. Other trials have shown that higher conception rates are attained from breeding by appointment 51 percent versus 39 percent. Since the Syncro-Mate B treatment can cause heat without ovulation in some non-cycling cows, conception rates of cows bred by heat after Syncro-Mate B may sometimes be low.

Progesterone-Prostaglandin Combination

A relatively new synchronization concept is the combination usage of progesterone-like compound such as Melengestrol Acetate (MGA) in combination with a prostaglandin.

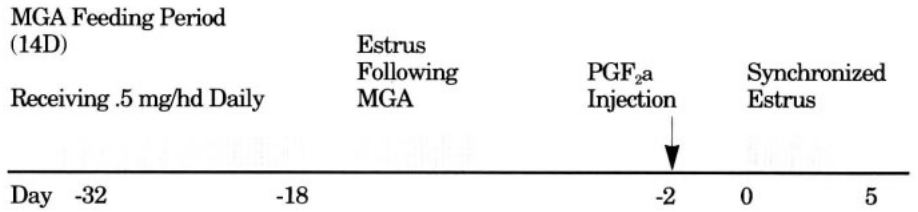
The use of MGA as a potential synchronizing product is not new. The heat synchronizing potential of MGA was evaluated as early as the 1960s. Feeding MGA for 10, 14 or 20 days was effective in synchronizing heat, but conception at the heat immediately after MGA feeding was reduced by as much as 40 percent. Some producers still used MGA, but skipped the first heat after MGA feeding and inseminated at the second heat. Heats were still synchronized to a period of about 10 days and conception rates were equal to those in non-synchronized cattle.

Research has been carried out in the past 3-5 years to evaluate feeding MGA for 5,7, 9 or 14 days with a prostaglandin injection either given at the end of the MGA feeding or 17 days after the last day of MGA feeding. The system involving short-term feeding such as 5, 7 or 9 days with prostaglandin given on the last day of MGA feeding has been fairly effective in synchronizing heat and has even induced cyclicity in some non-cycling females. However, this procedure has produced lower first service conception rates relative to non-synchronized controls. This reduced fertility is particularly evident in cattle that were greater than day 11-13 of the estrous cycle at the beginning of the MGA feeding.

Colorado researchers developed a system where MGA is fed for 14 days then prostaglandin is injected 17 days after the last day of MGA feeding. This system overcomes the problem of reduced fertility after feeding MGA and takes advantage of the fact that a prostaglandin administered late (day 10 to 15 of the estrous cycle) is more effective than when given early (days 5-10 of the estrous cycle).

As illustrated in the following example, this system is designed to place cattle in the late luteal phase of the estrous cycle at the time of the prostaglandin administration.

The most extensive use of this system in the cattle industry has been with heifers in which the feeding of MGA at the regular feedlot dosage (.5 mg/hd/d) is relatively easy to do as the MGA can be incorporated in a grain mix and added to the daily ration being fed the heifers. Thus, the system requires the cattle being handled once for the prostaglandin injection and then a second time for artificial insemination. In addition to the advantage of reduced costs, the system has also offered some indication of inducement of cycling in non-cycling females, although the results to date have been variable. Like all synchronization systems, however, the effectiveness of the



MGA-prostaglandin system is going to be greatly enhanced when cycling heifers are involved.

Both in research trials and field application (as illustrated in the following table) evidence indicates that most cycling heifers have been synchronized with normal fertility rates being achieved.

Kansas Field Trials That Utilized The CSU Heifer Synchronization System*

No. heifers involved	504
No. heifers bred in 3-4 days	396
% bred	78.6% (range 66.6% to 86%)
% 1st service conception rate	66.9% (range 56.4% to 74%)
% of all heifers pregnant after 3-4 days of AIing	52.5%
% of AI'd heifers open after 45-day breeding season	6.7%
% of non-AI'd heifers open after 45-day breeding season	23.4%

*5 Commercial Locations

To date, attempts to use this type of system with cows has been somewhat less effective. Considerable research is currently being done with cows and, it's hoped an effective system will be developed in the future.

Conclusion

Heat synchronization is an established practice in reproductive management of beef cattle, but its use has been limited primarily to producers that practice artificial insemination.

Undoubtedly, most failures in synchronization programs have resulted from the treated beef females not cycling before treatment. Before starting a heat synchronization program, it should be determined if the females are good candidates for synchronization (e.g. in good body condition, have had adequate postpartum periods). If available, calving records from the previous year are a good indicator of potential success. A maximum success rate (percent of cows conceiving during the synchronized period) expected would be the percentage of the herd that calved during the first 21 days of the previous calving period. The application of a synchronization system with heifers is often easier to accomplish than with cows because a higher percent of the heifers are cycling and nursing calves are not a problem. AJ