Artificial Insemination, Estrus Synchronization and Embryo Transfer: Evaluation of These Tools

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Does artificial insemination, estrus synchronization or embryo transfer have a place in your beef operation? Certainly each of these techniques has created quite a stir in the beef cattle industry during the past decade. One would think that artificial insemination would be a fairly common practice among the nation's beef herds, but still less than 5% of the total beef cow pregnancies result from artificial insemination. There are many advantages to the use of artificial insemination, but none are any more important than the use of genetically superior bulls on a larger number of your cows.

The purebred herds at OSU and the Angus operation at the Drake Farms have been basically built through extensive use of A.I. Without exception, every mature cow is inseminated at least once with semen from National Reference Sire Bulls. Bulls used in our programs are selected primarily for high yearling weight breeding values and high maternal breeding values with emphasis on the frame size of their progeny. Semen costs are really inexpensive in the long run and when one considers the overall benefits to herd improvement, non-use of A.I. seems to be a tremendous mistake. Certainly there are problems. Most breeders who are not currently using A.I. simply say that the increased labor, especially heat detection and insemination, and management necessary to do a good job does not lend itself to their operation. In most instances when A.I. was used in the past, poor heat detection and improper insemination has resulted in poor conception rates and a general "poor taste in the mouth" of the producer. The first service conception rates in our programs are approximately 60-70%, depending on the year. The use of marker bulls has greatly helped in heat detection, but considerable time is needed to do a good job. Even so, with the techniques available to the producer today, it seems extremely difficult not to justify the use of artificial insemination in your herd.

Just as with artificial insemination, controlled estrus is certainly not for everyone. The level of management necessary for estrus synchronization and artificial insemination to work effectively must be excellent. The benefits are numerous: 1) increased use of genetically superior sires or crossbreeding through A.I.; 2) reduced heat detection time; 3) shorter breeding and calving seasons and 4) more uniform calf crop in terms of age, size, weight and genetic makeup. But just as there are benefits, a poorly constructed estrus synchronization program will result in massive headaches and money down the drain. The success of any program utilizing both estrus synchronization and artificial insemination largely depends on the level and quality of management. Accurate records and careful planning are essential for any program to be successful. Adequate labor must be available for proper heat detection as well as moving the cattle through the chute and certainly, sufficient inseminators must be present to handle large numbers of synchronized cows in a short period of time. Facilities must be workable,

allowing for rapid movement of cattle through the breeding chutes with a minimum of noise and labor (minimum of one head per minute). The breeding area should be sheltered from the weather, both cold or hot sunlight, and conveniently arranged for easy breeding and record keeping. Facilities should not be taken for granted. Inseminating large numbers of cows or heifers in one day is quite an experience. An experienced inseminator can only handle 30 heifers or 40 cows per day effectively. Be prepared to have sufficient inseminators on hand.

The major problem facing the cattle industry in attempting to synchronize the estrus activity of the cow herd is a failure to properly understand the estrus cycle of cattle and the capabilities and limitations of prostaglandins. Prostaglandin is not a cure-all for problems associated with poor management. Since the synchronizing action of prostaglandins is achieved by the regression of a functional corpus luteum, only normal cycling cows can be expected to respond to synchronization via a prostaglandin injection.

There are many reasons why cows fail to exhibit estrus activity early in the breeding season:

1. Nutrition - The most common cause of poor cycling and conception rates is inadequate nutrition, particularly energy levels, 50 days prior to calving and immediately post-calving through 120 days into the lactating period. Restricting the level of energy prior to calving will markedly increase the number of days from calving to first observed estrus and reduce the percentage of females cycling at the start of the breeding season. Most ranchers relate nutritional status of the cow herd to cow condition. As cow body condition at calving increases, the percentage of cows cycling early in the breeding season also increases.

2. Post-partum Interval - Sufficient time after calving is essential for each cow to recover and begin cycling again. Generally, mature lactating cows require 30-50 days post-partum to exhibit estrus, while lactating first calf heifers require 50-70 days. The higher the percentage of cows exceeding 80 days post-partum, the greater your chance for a successful synchronization program.

3. Age of Female - Heifers must be in a high plane of nutrition and have attained approximately 65% of their mature weight by 14-15 months of age prior to being placed in a synchronization program. Under these nutritional conditions, usually a higher percentage of yearling heifers will be cycling at the start of the breeding season than will mature, lactating cows. However, first calf lactating heifers require about 20-30 days longer than mature cows to recover and cycle after calving.

Since prostaglandins are non-effective in non-cycling females, heat detection for 5 to 10 days prior to the beginning of the synchronization program will give a good estimate as to the percentage of your cows cycling. On the average, 4-5% of your cow herd should be cycling on any given day; therefore, depending upon the number of cows observed in heat per day during an estrus detection study one week prior to the desired synchronization period, a decision to inject or not can be made. If less than 3% are cycling per day, your cycling rate does not appear good for a successful

synchronization program.

To understand how prostaglandins may help synchronize estrus, an understanding of the events during the normal 21 day estrus cycle in cattle is essential. On Day 1, the cow displays the familiar signs of heat: standing to be ridden, excretion of mucus, bawling, etc. A mature follicle exists on one ovary with a mature egg inside. Estrogen production by the cells lining the inner follicular wall increases and the cow exhibits heat symptoms. One Day 2, the follicle ruptures, releasing the mature egg into the oviduct (ovulation). Estrogen production begins to decrease. During Day 3, luteal cells begin to develop in the depression left by the by ruptured follicle. By Day 6, a functional corpus luteum has developed in the depression and production of progesterone by the corpus luteum increases. The principal purpose of the corpus luteum is the production of progesterone which blocks the production of follicle stimulating hormone and prepares and maintains the uterus for pregnancy. If the female was bred on Day 1 and pregnancy resulted, the corpus luteum remains functional throughout the pregnancy. It is important to note that regression of the corpus luteum, prior to 180 days of pregnancy, will result in abortion. However, if the female is non-pregnant at Day 6, the uterus will begin production of a natural prostaglandin by Day 16 or 17. The natural prostaglandin dissolves the corpus luteum, resulting in reduction of progesterone production and removal of the block on follicle stimulating hormone. New follicles will begin to develop on the ovaries. As the follicle matures, estrogen production increases and by Day 21, the follicle has matured, estrogen production is high and the cow begins to display signs of heat once again.

Since prostaglandins will regress the corpus luteum, we can use this information to help change the 21-day estrus cycle and bring groups of cows into standing heat within a short time period. However, for an injection of prostaglandin to work, a functional corpus luteum must exist or the cows must be in Day 6 to Day 16 of her estrus cycle. An injection of prostaglandin within this time frame will result in a regression of the corpus luteum and the cow will return to heat within 2-5 days. Prostaglandins do not work between Day 18 and Day 6 of the cycle or those animals coming into or just going out of heat. Thus a second injection is necessary 11-12 days after the first to synchronize all animals.

There are several different procedures being used in synchronization systems. A single injection system employs visual heat detection for 4-5 days prior to scheduled injection. Cows detected in heat during this period should be inseminated 8-14 hours after first observation of standing heat. If by the morning of Day 5, 12% of your herd or less has been observed in heat, STOP! An insufficient number of your cows are cycling and you will be throwing money away. If the decision is made to continue, inject all cows not already observed in heat with 5cc of Lutalyse. Continue heat detection and breed 8-14 hours after standing heat. Peak activity should be around Day 7 or 8. This procedure requires rather intensive heat detection and labor for approximately 10-14 days.

Another procedure commonly used in many operations has been the double injection - single forced insemination at 72-80 hours with no heat detection. Basically the procedure employs injection of every cow on Day 1, followed by another injection on Day 12 and forced breeding at 72-80 hours. This procedure is good if heat detection is impossible, however, results have been poor. At the Drake Farms over the past three

years, 295 cows and 109 open heifers have been injected with the procedure. Of the mature cows, 101 settled or 34.2% and 50 open heifers settled or 45.9%. These results are very typical of the industry. Some results suggested that forced breeding should be at 60-70 hours rather than 80. The poor results largely being due to the improper breeding time of the cattle. To help this situation, observe heats following the second injection and breed cows 8-14 hours after the first observed in standing heat. Peak activity should be around Day 15. Conception rates will be better, but more time is involved. Both systems may be extended by observing heats between Days 32 and 39. The cows should be returning to estrus during this period and a second insemination would be possible before clean-up bulls were turned in.

Another procedure involving more detection time and labor would be a two injection-split insemination procedure. In this procedure, all cows are injected on Day 1, heat is detected and cows showing estrus are inseminated between Days 2 and 7, on Day 8 inject all cows not bred and detect heat and A.I. on Days 9 through 13. This procedure requires intensive activity for two weeks. If a good technician is available, palpation on Day 1 for a functional corpus luteum will cut down on injection costs. Those cows with a functional C.L. are injected with Lutalyse. Heats are detected from Day 2 through Day 5 and cows detected in estrus are bred. On Day 12, palpate all cows without functional C.L. on Day 1. Those with functional C.L., inject with Lutalyse. Detect heats and A.I. on Days 13 through 16. This procedure will inject only those cows with Lutalyse in which the drug should be effective.

Many synchronization programs fail simply through improper administration of the drug. The injection should be intramuscular, with an 18 guage 1¼-1½ inch needle and dosage should be 5cc with an additional cc per 200 lbs. body weight over 1000 lbs. Remember, the cows must have cycled in the previous 21 days in order for the drug to be effective. The post-partum interval on lactating cows is important. The impact of prostalandins should be tremendous but may not be realized for years to come.

Embryo transfer in beef cattle is a relatively new reproduction technique that has created a tremendous amount of excitement in the purebred business. Certainly many beef cattle producers have questioned the role of embryo transfers in the total beef production scheme, but others view transferring as a means of shortening the generation interval, increasing the number of progeny out of outstanding cows as well as making genetic progress quickly. Today, when purebred breeders gather at livestock events throughout the country, embryo transferring usually begins to surface in the conversation. Questions like, "How much improvement did you really get?", "Which cows did you flush?", "What is the real breeding value of your embryo calf?" and "What did it cost?", are often asked.

The selection of the donor cows and the sire or sires of the potential embryo calves are major decisions in anyone's mind. Many times the wrong cows are placed in transplant because they were the "favorite", were 58 inches tall and weighed 1800 lbs. or raised an outstanding calf five years ago. Breeders no longer have just the option of culling open or unsound cows from the herd, he can now put them in embryo transfer. However, only females with high breeding values for growth and maternal ability and have had a 100% calf crop with a calving interval less than 365 days should be considered for embryo transfer. The more information available on the donor cow, the

likelihood of superior progeny will increase. Some breeders have started transplanting heifer calves. Certainly this is the best method of shortening the generation interval and making rapid progress, but the real breeding value of the female is unknown.

The same goes for the sire. With the National Reference Sire Programs available in most breeds, the risk of using an unknown bull is removed. At least we have good estimates of the genetic potential of the sire. The predictability and marketability of the progeny are extremely important.

What about success and costs? In an average good donor flushing, 12 unfertilized ova and embryos are recovered. Of the 9 embryos recovered, 6 are of a quality to be transferrable and of these 6, 4 will result in pregnancy. In work at Colorado State University, approximately 2% of the recipient cows diagnosed pregnant at 3 months gestation, abort before calving. Another 4% of the calves die at birth and 4% of the calves die between birth and weaning. Therefore, only 90% of the 3 month pregnant recipient cows wean a calf. The costs get pretty high!

If we consider two different situations, embryo transfer clinics or on-the-farm transfer, the costs differ somewhat. Fees generally paid to the embryo transfer clinic would be $2 per day for board, a $500 entrance fee per donor cow and $2000 per 90-day pregnant recipient, furnished by the clinic. If we include other costs such as semen, trucking, feed, registration fees, interest on direct costs and a 10% death loss before weaning, each transplant weaned calf has accrued costs of $2500-$3000 after the recipient cow has been sold for salvage. The on-the-farm situation differs in that multiple donors are involved and the ranch operation furnishes the recipient cows. The services provided by the embryo transfer company are limited to providing superovulating drugs, recovering, isolating, evaluating and transferring embryos. Non-surgical transfers usually result in a 50% pregnancy rate, so an average flushing will generate 2-3 pregnant recipients per donor cow. Fees paid to the transfer company would be a one-time set-up fee of $1000 and a $400 per pregnancy charge plus travel expenses. Assuming the semen, feed and care of recipient cows, registration fees, interest and 10% death loss before weaning, each on-the-farm transplant weaned calf has accrued costs of $1500-2000. The on-the-farm situation seems cheaper, but rarely is it profitable to try to transplant fewer than 3 donors on the farm and considerable time and labor are necessary to properly synchronize large numbers of recipient cows.

Lastly, one of the biggest problems involved in embryo transplant - the sex ratio of the calves. Everyone is looking for females or that one great bull calf and certainly don't want to try to market 10 full brothers. The problem does exist and until sexing of embryos becomes possible and economically feasible, the ratio of bull and heifer calves will continue to be a financial headache for many producers.

Maybe this discussion will spur some interest and we can have a good concurrent session during the conference.