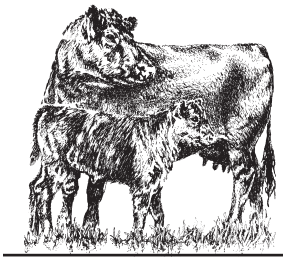

Western Beef Resource Committee *Fourth Edition*

Cattle Producer's Handbook

Reproduction Section 407

Artificial Insemination for Natural Service: An Economic Comparison

Jim Keyes, Extension Area Beef Specialist
Utah State University

History

Research has helped us understand more about the physiological processes in the food-producing animals. Innovations have made it possible to manipulate food animals to increase their productivity. Estrus synchronization and bovine artificial insemination (A.I.) are examples of scientific discoveries revolutionizing the beef and dairy industries of the world. Cattle producers can more accurately control the mating of sire to dam to hasten genetic improvement.

The history of research in A.I. is lengthy and diverse. Spermatozoa were first observed under a microscope in 1677. In 1780, a dog was impregnated using the cellular portion of sperm. By 1933, methods for collecting semen and inseminating farm animals were established.

Three significant research discoveries in this field opened wide the gates for the cattle industries to move forward at rapid pace: (1) the development of semen extenders, which would protect sperm cells against temperature shock and thereby allow cold storage; (2) the realization that bull semen could be extended to breed large numbers of cows from each ejaculate; and (3) the discovery of methods for frozen storage of bull spermatozoa.

Artificial insemination in dairy cattle began in the 1930s with the first A.I. co-ops appearing in 1937. By 2010, about 66 percent of dairy cows in the U.S. were bred A.I. with 85 percent of all Holsteins a product of A.I. (Blezinger 2010).

Although A.I. of cattle has been possible for 60 years, this technology has not been used widely in the beef industry. Only 10.6 percent of western beef operations use estrus synchronization, and 13.6 percent of operations use A.I. (NAHMS 2009). In a study by the National Animal Health Monitoring Service (NAHMS 2009), only 6.4 percent of the cows represented in the study were either bred A.I. or bred A.I. followed by natural service.

As techniques and protocols improve, there are many reasons why beef producers should look at estrus synchronization and A.I. as part of their herd reproductive management. Genetic evaluation of beef bulls has improved considerably in recent years, making bull selection more objective and reliable. Sexed semen, expected progeny differences, and the ability to select for specific traits identified through DNA markers are also now available. Considering the costs of natural service and lost genetic opportunities, estrus synchronization and A.I. can be profitable, even in commercial cattle.

Estrus Synchronization and A.I. in the Beef Herd

The use of 100 percent A.I. on range type commercial cow-calf operations is not usually feasible. In some cases it is possible to synchronize the cowherd and do a timed insemination before turning in clean up bulls. Everything depends on available feed resources and facilities.

In most all cases it is necessary to include an estrus synchronization protocol for A.I. to be most effective in commercial beef operations. Comparing A.I., strictly on its own merits, to natural service is not practical. Too many variables cannot be accounted for. However, the information presented here is a simplified comparison of estrus synchronization plus A.I. with the use of bulls only. Though this comparison is basic, it can be helpful to any beef producers considering a synch/A.I. program.

Why Consider Estrus Synchronization and A.I.?

Before the two strategies for breeding can be compared economically, it is necessary to consider the possible benefits of using a new technology such as synchronization and A.I. Cattle ranchers are not often inclined to move from something that is working to adopt a new idea that may or may not be beneficial. The following is a list of probable advantages of using estrus synchronization and A.I. for beef producers to consider.

Controlled Calving Season

Controlling the length of the calving season using estrus synchronization is important for all beef cattle herds, but especially critical when considering first-calf heifers. These young females are not only maintaining a pregnancy and giving birth to a calf but are also trying to sustain their own body functions and continue to grow to mature size. All of this dictates that they receive intensive care before, during, and after parturition.

Being able to control the length of this labor-intensive period can have lasting effects during the season and also throughout the reproductive lifetime of the female. A well-designed estrus synchronization and A.I. program can have a positive impact on the reproductive lifetime potential of cows (Overton 2005).

Benefits of a controlled calving season:

Increased Calf Crop Uniformity—More calves born early due to synchronization/A.I. reduces the number of late born, smaller calves at weaning. The result is increased value due to uniform age and size of the calves. Additionally, A.I. sires can be used to ensure uniformity of breed, color, and conformation. These factors enhance the value of the calf crop.

Increased Weaning Weight—Synchronization and A.I. can achieve more pregnant cows early in the breeding season. This means more calves born earlier in the year leading to more pounds of beef at weaning time.

Increased Reproductive Performance—Cows that conceive earlier and calve earlier have a longer period of time to rebreed during the postpartum period and are less likely to be open and culled at weaning time.

Genetic Enhancement—Artificial insemination gives a beef producer the opportunity to breed to sires that can enhance the genetic makeup of the cowherd in one generation. Producers can achieve rapid genetic progress using proven sires that are known to possess valuable traits. Most cattle growers could never hope to own such high-powered, proven sires due to economic restrictions.

Greater Selection Opportunities

In the modern beef industry there are many exciting tools that can be used in the sire selection process. Expected Progeny Differences (EPDs) provide estimates of the genetic value of an animal as a parent. Differences in EPDs between two individuals of the same breed predict differences in performance between their future offspring when each is mated to animals of the same average genetic merit.

Taking this a step further, producers can now use genomically enhanced EPDs to provide a more thorough characterization of economically relevant traits with improved accuracy on young animals. In the past, it took years to evaluate the progeny of a bull and come up with accurate EPD calculations. Now the process has been sped up and more accuracy provided. Using genomically enhanced EPDs, breeders can select for key traits that can improve many aspects of production. Ranchers can pick bulls with the traits that are needed to improve their herd with a sense of confidence.

In times past bull buyers would never think of purchasing anything without first seeing the bull in person. Many ranchers did not understand that a young bull might have excellent confirmation and rapid growth numbers, but he may not pass those positive characteristics on to his progeny. Genomic-enhanced EPDs have taken some of the guesswork out of the selection process. Bulls can be safely selected on paper by the numbers, without ever having a visual inspection, if necessary.

Estrus Synchronization

As mentioned previously, in most all cases it is necessary to include an estrus synchronization protocol for artificial insemination to be most effective in commercial beef operations. Synchronization of estrus (heat) involves manipulating the estrous cycle of beef females so they can be bred at approximately the same time. Several protocols are available for synchronizing estrus among beef females. Protocols are basically methods of synchronizing that involve multiple phases (see fact sheet 405).

Synchronization and Artificial Insemination (synch/A.I.) vs. Natural Mating: An Economic Comparison

Unfortunately, the definitive comparison of synch/A.I. vs. natural mating has not been accomplished. It is difficult to quantify without the use of economic models based on a myriad of assumptions. It has been suggested that the true economic difference between synch/A.I. and natural service is probably not huge (Johnson 2002). However, on a case-by-case basis, substantial differences probably exist.

What follows is a simplified version of costs and returns associated with synch/A.I. vs. natural mating. Despite the generalization of these figures, they still provide enough information for a producer to make a confident decision as to how this would impact a beef operation.

Table 1. Cost of bull ownership.

a. Bull purchase price	$4,000
b. Bull salvage value (1,800 lb x $92 cwt)	$1,656
c. Annual maintenance cost[1]	$725
d. Annual ownership cost[2]	$781
e. Risk of bull loss[3]	$57
Total annual cost of bull ownership/maintenance (c+d+e)	$1,563

[1]Maintenance costs include feed, vet costs, interest, etc.

[2]The average annual decline in the bull's value. Calculated as the difference between the bull's purchase price and his salvage value divided by his useful life (3 years).

[3]Risk of bull loss represents potential financial loss due to a bull's death. $4,000 + $1,656 = $5,656 ÷ 2 = $2,828 x .02 (probability of death) = $56.56.

Table 2. Cost per pregnancy.

Cows exposed	Cost per pregnancy
15	$104.20
20	$78.15
25	$65.52
27	$57.89
30	$52.10

Natural Mating

In a natural mating scheme it can be assumed that one bull will cover 25 to 30 cows depending upon the breeding conditions. In an effort to compare the two strategies to get cattle pregnant, it is important to first establish the cost of natural service. For discussion sake, let's assume a bull will cover 27 cows. Table 1 shows the cost of natural mating for this bunch of cows.

Table 2 shows the various costs of getting a cow pregnant using a bull with a $4,000 purchase value and a 3-year useful life in the herd. The cost of pregnancy for the 27 cows in the example would be per head. It is obvious that the cost is lower when a bull covers more cows.

The estrus synchronization protocol or plan for this example is CoSynch using CIDRs. This protocol has been shown to be successful and accepted in the beef industry. It involves injecting the cattle with gonadotropin releasing hormone (GnRH) on the first day known as Day 0. On Day 7 the animals are injected with a prostaglandin such as Lutalyse. On Day 9 everything is Timed Inseminated (the whole herd is inseminated) and a final injection of GnRH is given. The benefit of this protocol is that extensive time is not needed for heat detection. The same protocol can be used on heifers, however, there are several protocols to choose from depending upon time frame, facilities, and finances.

Table 3. Direct costs using CoSynch plus CIDRs protocol per insemination.

Item	Cost
Prostaglandin (Lutalyse)	$3.40
CIDR	$11.48
GnRH x 2	$6.12
*Supplies	$1.00
Semen	$20.00
Technician	$10.00
Total	$52.00

*OB gloves, syringes, needles, etc.

Fig. 1. CoSynch protocol plus CIDRs.

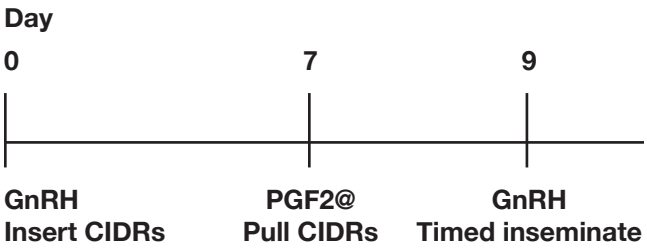

Fig. 1 shows the timeline and process of CoSynch. Table 3 shows the individual costs of using CoSynch plus CIDRs on a mature cowherd.

It is important to remember when using synch/A.I. to pay strict attention to all aspects of the synchronization protocol. Pregnancy rates can be quite low if all facets of the protocol are not followed precisely.

Conclusions

As mentioned earlier, it would be incredibly hard to accurately compare synch/A.I. with natural mating over the entire beef industry. However, on an individual operation basis a reasonably precise comparison can be made. To achieve an optimum outcome in any breeding program, managers need to carefully look at the pros and cons of the two breeding methods.

The genetic enhancement of the offspring, especially any females kept as replacements, has to be a major consideration when looking at artificial insemination. In dairy cattle, the use of natural breeding under optimal scenarios is estimated to provide genetic gains of 0.5 to 0.6 percent each year. Optimum use of A.I. is estimated to increase rate of genetic improvement to 2.0 to 2.5 percent in dairy cattle, but these figures are not known for beef cattle (Van Vleck 1981).

Financial rewards from the augmentation of herd genetics may stretch on for years. If time and facilities are issues, natural mating may be the best way to get cows bred.

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