Western Beef Resource Committee

Cattle Producer's Library

Reproduction Section CL404

Artificial Insemination of Beef Cattle

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Artificial insemination (A.I.) is one of the most valuable management practices available to cattle producers. It requires sound management and planning to be successful, however. The single most important factor affecting the success of the program is the attitude of the manager. He/she must be totally committed to an A.I. program. The weakest link in management sets the level of success for the operation. Should any aspect of management become subpar, A.I. conception rates and the benefits of this valuable program may suffer.

Many managerial decisions relative to feeding, facilities, fences and corrals, equipment, labor, sire selection, and so forth will be necessary. A sound herd health program and good nutrition are requirements of any breeding program, but they become even more important in an A.I. program. As management skills improve, labor requirements will be reduced, but the requirements will also remain above the requirements of natural mating.

Advantages of A.I.

1. Faster genetic process through the use of semen from genetically proven sires.
2. Control of venereal and other diseases.
3. Improved record keeping. Breeding dates will be known, so calving dates can be better estimated. Calving season is actually scheduled.
4. More economical than natural service when genetic merit is considered.
5. Facilitates crossbreeding and/or selecting the appropriate sire for each dam.
6. Earlier identification of fertility problems to improved management.

Disadvantages of A.I.

1. Requires better management.
2. Requires trained individuals.
3. Requires special facilities for corralling and insemination.
4. Requires extra time and commitment for estrous detection.

A manager contemplating using A.I. must be knowledgeable in many different aspects of beef production, such as:

1. Herd identification
2. Nutrition
3. Cow estrous cycle and heat detection.
4. Sire selection.
5. Facilities.
6. A.I. equipment.
7. Semen storage and handling.
8. Insemination procedures.

Herd Identification

Each female in the herd must be individually identified so that accurate estrous detection and record keeping are possible. Several suitable identification methods are available. Characteristics of a good identification system include permanency (not easily lost and will not fade) and visibility (easy to read from a distance). Ear tags and brisket tags with large numbers provide good identification systems. However, a backup system such as tattoos, brucellosis tags, or numbered freeze brands help identify cattle that have lost their tag. An individual identification is necessary to provide a record for when each female comes into heat, date of breeding, sire bred to, pregnancy status, and anticipated calving date.

Nutrition

Inadequate nutrition can decrease conception rates at several critical periods during the female's life. One of the most critical periods is from weaning to breeding in replacement heifers. If a heifer is to calve as a 2-year-old, she must be pregnant at 14 to 15 months of age. To attain a high degree of fertility, she should weigh at least 60 percent of mature weight at breeding time, having gained at least 1 pound per day from weaning to breeding. Heifers that are bred to calve 3 to 5 weeks ahead of the cow herd are more likely to rebreed as 2 year olds and thus, remain in the herd.

Another important nutritional period for a cow is from 3 months before calving to 3 months after calving, with the period from calving to rebreeding being the most critical. During this time, a cow will usually be losing weight because of milk production demands. Cows undernourished at this time may fail to rebreed or have lower conception rates on embryonic survival.

Before calving, a mature cow needs between 9 and 11.5 pounds of total digestible nutrients (TDN) per day depending on her size. A shortage of energy at this time will cause a delay in her return to estrus after calving.

After calving, a mature cow requires 11 to 15 pounds of TDN daily to permit her to gain weight and supply milk for her calf. Differences in cow size and milking ability are major factors influencing a cow's energy needs after calving. Underfeeding during this period may lower conception rates and embryonic survival, resulting in a reduced calf crop.

Many range feeds in the mountain states are low in dietary crude protein. Diets low in protein are known to reduce reproductive performance after calving even if energy is adequate. Producers should assure that the cow receives approximately 2.25 to 2.5 pounds of crude protein per day after calving. Protein supplementation may be required for late-harvested, low-quality forages.

Vitamin A and phosphorus are also essential nutrients for normal reproduction and growth. Daily requirements for both of these nutrients are nearly double during pregnancy and lactation. Since these nutrients are especially important for cycling and conception, supplying adequate amounts of both Vitamin A and phosphorus before calving and throughout the breeding season may enhance breeding performance, particularly of first-calf heifers.

Trace minerals should always be available. Animals ranged on or fed feeds from mountain meadows may require supplemental copper. Selenium is also deficient in many areas of the mountain states.

Cow Estrous Cycle and Heat Detection

Estrus, or heat, is the short period (2 to 16 hours) of sexual receptivity of a cow that occurs every 17 to 24 days until conception. Under natural conditions, a cow is bred by the bull several times during heat. The cow, or heifer, permits other animals to mount her while she remains standing; this is the surest sign of heat. Standing for other cows is obvious in a group of cattle milling around attempting to mount the cow in heat. Cows in heat will usually attempt to mount cows not in heat. Keep in mind, however, that only those cows that remain standing when mounted by other cows are in heat. In most cases, cows in a sexually active group are either coming into heat, in heat, or going out of heat. Removing the cow or cows that are receiving the most mounts from this group will encourage more submissive cows to display estrus.

An observer should look for secondary signs of estrus. The cow in heat may attempt to ride several different females; she may follow them, stand beside them, and put her head on their back or rump. Many cows bawl or bellow considerably during their heat period. Others will exhibit restlessness and walking in search of a bull, pace along a fence, or try to go through it. Sometimes clear mucus may be seen flowing from the vulva indicating that the cow is close to estrus. Oftentimes this mucus can be observed on the buttocks or as strings on the tail. This is also a strong indicator of estrus.

Changing from a natural breeding program to artificial insemination will increase labor demands. Heading this list is the major task of heat detection. Cows should be observed for signs of estrus at least twice daily. More cows are detected in estrus in the early morning than any other time of day. Females should be observed for estrus at least twice a day for 30 to 60 minutes.

Those animals found in estrus in the morning are inseminated roughly 12 hours later in the evening. Those animals found in estrus in the evening are inseminated the next morning.

Another important management decision in an artificial breeding program is determining the length of the breeding season and the use of cleanup bulls. Breeding by A.I. alone is only practical in intensively managed herds of cattle. Most insemination programs last 25 to 28 days. This length of breeding season allows two opportunities to breed synchronized cows and at least one opportunity to breed all cyclic cows. Cleanup bulls are then turned in with the cows. This assures that any cow that failed to conceive during the A.I. program will have an opportunity to be bred by the cleanup bulls.

Planning the Breeding Season

Planning for the upcoming breeding season should include the following considerations:

1. Determine which cows will be eligible to breed artificially during the planned A.I. breeding period. Cows should have a minimum of 45 days between calving and the beginning of the A.I. program.
2. Decide whether an estrous synchronization program will be used to facilitate estrous detection. Select a plan that fits your resources.

3. Important information can be gained by observing cows for signs of estrus before the start of the breeding season. At least 2 weeks before the start of the breeding season, the herd should be moved into small pastures where heat detection will be easier. This will permit the cattle to become familiar with their surroundings, and normal cycling will not be upset. Make sure that these pastures contain adequate feed.
4. Observe the cattle in the pasture to determine (a) if females are cycling and (b) to provide some indication of expected breeding dates after onset of the A.I. period. On the average, 5 percent of the cows in a herd should be in heat each day if all cows are cycling.
5. Should heat detection devices be used? Heat detection aids that are available include the Kamar detector, painted/chalked tail heads, chin-ball markers, gomer bulls, vasectomized or otherwise altered bulls, androgenized females, and electronic heat detection systems. These are the detection systems discussed in the following section.

Heat Detection Aids

Kamar Detector—This 4 1/2 x 2 inch detector is applied with adhesive over the sacrum of the cow between the hip bone and the tail head. It remains white until it is triggered. It is triggered when the pressure from the brisket of a mounting cow turns the detector a bright red indicating that the cow is in standing heat. Cost is about $1.50 per cow.

Painted/Chalked Tail Heads—The simplest and perhaps most economical aid for detecting estrus is to smear liberal amounts of chalk or paint on the tail head of cows. Livestock paint sticks work well and will last several days. Other paints may be suitable. This procedure is especially helpful for synchronized herds, since most paints or chalk will not be visible after a couple of weeks.

Chin-Ball Marker—This marker device fits under the chin of the teaser (gomer) bull or androgenized cow. As the animal wearing the device mounts and slides off the cow, an ink mark is left on the back and hip of the cow that has been mounted. Cost is about $150 plus ink.

Gomer Bulls—Bulls that have been equipped with a Penile Block device are proven companions to the chin-bull marker. The Penile Block does not deter normal bull mounting but does prevent extension of the penis and insemination. Installation is not difficult but must be properly installed. The services of a qualified veterinarian are recommended for the procedure. This procedure is usually only effective for short periods of time since most bulls so equipped tend to lose sex drive rather quickly. This method prevents copulation and helps prevent the spread of venereal diseases.

Vasectomy—Vasectomy is a surgical procedure in which the vas deferens (tubes that carry sperm from the testes to the penis) are severed, resulting in sterility.

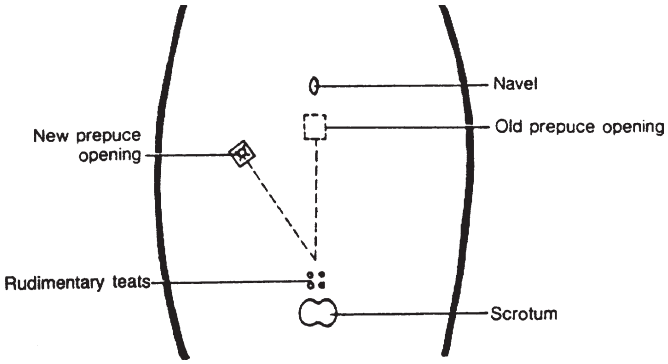

Fig. 1. Redirected prepuce procedure.

Since the blood and nerve supply to the testes are not interrupted, the bull remains normal in all other aspects. Thus, vasectomized bulls have normal libido and are helpful for identifying females in estrus. Chin-ball markers work well on vasectomized bulls also. Venereal diseases can be spread by vasectomized bulls.

Redirection of the Prepuce/Penis—Redirection of the prepuce and penis is another method of altering bulls so they can be used for estrous detection. The purpose of this procedure is to move the opening of the prepuce (Fig. 1) to one side so that the penis fails to line up with the vulva of the female, thus preventing breeding. Males with a redirected prepuce are more advantageous for detecting estrous females than either vasectomized males or males with a Penile Block. The problem of disease spread and loss of sex drive is eliminated, resulting in a bull that would be useful much longer.

Caudal Epididymectomized Bull—Caudal epididymectomy has been used extensively for many years in Australia and New Zealand and to a limited extent in the U.S. during the past decade. To perform a caudal epididymectomy, an incision just long enough to allow the epididymis to pop out is made in the bottom of the scrotum. The protruding tail of the epididymis is then removed with scissors and cauterized. This procedure is relatively simple to perform and has served as an easy and economical method of preparing a teaser bull. This procedure prevents sperm from reaching the penis, but does not prevent copulation or the possible spread of venereal disease.

Androgenized Females—Some livestock managers prefer to use cull heifers or cows that have been treated with androgens (mainly testosterone) as teasers. Androgenized females can be used for long periods of time, are safer than bulls, and the injection of androgens is usually cheaper than surgically altering a bull. Older cows (6 to 8 years old) appear to work better than younger cows. Androgenized females can be fitted with chin-ball marking devices to help identify cattle that are in estrus. One androgenized cow should be sufficient for each 30 synchronized cows or 50 non-synchronized cows.

Testosterone propionate is the hormone of choice for producing androgenized females and can be purchased through your local veterinarian. This hormone is injected at the dose of 200 mg every other day for 20 days before the breeding season. At this time the cow can be used as a teaser animal. Booster shots of 200 mg must be given every 10 days during the breeding season. The cost of hormone is less than the cost of surgically altering a bull. The cow used as an androgenized cow can be one that has lost her calf, thus eliminating the need for maintaining extra animals throughout the winter just for teaser animals.

Synovex H, a hormone implant for increasing growth efficiency in feedlot heifers which contains estradiol valerate and testosterone propionate, can be used for androgenizing a teaser cow. Place five implants subcutaneously in the ear of the teaser cow. The testosterone propionate in these implants will keep the cow active for several months. However, be sure to remove the implants before sending these cows to slaughter.

Electronic Heat Detection—Newly developed electronic heat detection systems (HeatWatch) are also available. These systems consist of electronic transmitters, receivers, a computer, and the necessary computer software. Using this system, cows are fitted with electronic transmitters. These transmitters are glued to the cow's sacrum, just in front of the base of the tail and between the hooks and pins. When a cow is mounted, the pressure activates the transmitter. A signal is sent to the receiver which in turn relays the message to the computer. The computer processes the signals recording the cow's identity, location, and the time and duration of the mount. When compared with visual detection, this system improved heat detection by 14 percent in estrous synchronized cattle and 80 percent in repeat breeders.

Sire Selection

Several areas need to be evaluated with regard to the bull. Decisions the ranch manager must make are:

1. **Sire breed selection:** Should strait or crossbreeding be used with A.I.?
2. **Number of sires to use:** Should a majority of the cow herd be bred to one bull or should several different bulls be used? In a large herd, use of semen from more than one bull may help avoid catastrophes.
3. **Trait selection:** Should the semen purchased be from bulls noted for producing good females or should terminal cross sires be considered? Use EPDs (expected progeny differences) to choose bulls with superior traits that have a high accuracy figure. When selecting bulls for certain traits, please note that the average EPD for most traits is not zero. Consult your sire directory.
4. A producer should consider selecting different sires for breeding first-calf heifers and mature cows.
5. **Source of Semen:** Be sure to purchase semen from a reputable source.

Facilities

Proper facilities are essential to the success of an A.I. program. The facilities can be simple or elaborate. A simple chute system can be developed that will be adequate. Totally enclosed breeding boxes are convenient and appear to calm cattle, but are not essential. If you have a herd of less than 25 cows, an alley 8 to 12 feet long by 26 to 30 inches wide (inside measurements) and 5 feet in height will be adequate. Space boards so that a bar can be placed behind the cow just above the hocks. A crowding pen large enough to hold two to three cows will be adequate. For larger operations, additional chute area and holding pens capable of holding 3 to 4 percent of the herd will be necessary.

In designing a facility for an A.I. program, the goal is to minimize the force required in handling cattle. The gathering and sorting of large numbers of cows to be bred can be a simple procedure if the trap, holding pens, and chute are designed and constructed properly. Keeping cattle comfortable and reducing handling stress may increase conception rates.

A.I. Equipment

A liquid nitrogen tank with one or more canisters is needed to store straws of semen. In addition, the following equipment is recommended to ensure proper straw handling and insemination procedures:

1. Forceps to remove straws from the tank.
2. A 1-pint, insulated, wide mouth thermos with a dial thermometer or an electric thaw bath to hold thaw water at a constant temperature.
3. Sharp stainless steel scissors or a cito straw cutter to cut straws.
4. An insemination gun with a plunger to expel the semen.
5. Plastic disposable sheaths to cover the insemination gun and prevent the spread of disease.
6. A small plastic "O" ring to lock the gun and sheath cover together (Universal guns only).
7. Paper towels.
8. Arm-length disposable gloves.

All of this equipment should be stored in a separate tool box. This will protect the insemination equipment and keep it clean.

Semen Storage and Handling

Proper semen handling is necessary to obtain high pregnancy rates to A.I. Most semen is now packaged in .5 ml plastic straws. Each 5-inch straw is placed in a goblet with four other straws collected from the same bull. Two goblets are clipped onto a metal cane. Each cane is identified with the sire code printed on the top. These canes are stored in a liquid nitrogen container

designed to keep the semen frozen at -320°F. The nitrogen container is built on the same principle as a thermos bottle in that it utilizes double walled construction with an evacuated space between the inner and outer wall to provide the necessary insulation to maintain the desired temperature. It is important to record the liquid nitrogen levels in a tank on a weekly or biweekly basis to establish a schedule for replenishing the liquid nitrogen. Most semen tanks can go 15 to 20 weeks before needing to be refilled.

Straw Retrieval and Thawing—Keep a written inventory containing the location and number of straws for each sire in your semen tank. This is done to help prevent temperature changes to semen that are caused by repeatedly raising and lowering the canisters in the tank. To retrieve a straw of semen, determine its location from the tank inventory list. Remove the canister from its storage position and raise it until the cane tops are 2 to 3 inches below the top opening of the tank. Locate the cane you want. Using your fingers or forceps, remove one straw at a time from the top goblet. Place the straw in 95°F water to thaw for at least 30 seconds. For best results, thaw and use one straw at a time. Never refreeze semen. Maintain the temperature of the water bath as close to 95°F as possible. Never thaw semen in water that is greater than 98°F.

Insemination Gun Loading—Choose a sheltered area that is sheltered from direct sunlight and temperature fluctuations. Before loading the insemination gun, warm the barrel of the gun by rubbing it with a clean towel or keeping it inside your skirt. Remove the straw from the water bath and wipe it completely dry.

There are two different procedures for loading semen into the insemination gun that are based on the type of gun you have. The two gun types are the Universal gun with the O-ring and French gun with the spiral neck.

Universal Insemination Gun—Place the cotton plug end of the straw into the gun. With scissors, cut off the crimped end of the straw at a right angle. Slide the plastic sheath over the straw and gun and lock it into place with the O-ring. Place the gun back inside your skirt until you are ready to insert it into the cow. You are now ready to inseminate a cow.

French Insemination Gun—After drying the straw, cut off the crimped end and snap the cut end into the plastic adapter of the sheath. Pull the plunger back about 6 inches and place the barrel of the prewarmed inseminating gun over the straw and into the sheath. Give the sheath a twist to lock it into place. Place the gun back inside your skirt until you are ready to insert it into the cow. You are now ready to inseminate the cow.

Insemination Procedures

A cow is inseminated using the rectovaginal technique. This technique can be learned by repeated practice. It is accomplished by inserting the gloved left hand into the rectum of the cow. The cervix is located and grasped. The cervix can be identified from the vagina and uterus by its firm thick wall.

With a clean paper towel, wipe all manure and contaminating material from the vulva. The inseminating gun is inserted into the vagina at a 45 degrees upward angle and moved forward until it contacts the cervix. The cervix should be held by its posterior end with the index, middle finger, and thumb, leaving the other fingers free to guide the inseminating gun.

The left hand is used to guide the gun through the irregular cervical canal. The cervix contains many folds and it is necessary to manipulate the cervix in all directions to assist in passing the gun through the cervix. As the gun progresses through the cervix, the fingers of the left-hand move forward to the uterine body. The inseminating gun should be stopped when it reaches the uterine body and the semen should be deposited slowly in that location. Slowly withdraw the insemination gun and your hand and gently massage the clitoris (bottom of the vulva) for 1 to 3 seconds.

Successful artificial insemination of beef cattle requires a manager with a desire to make the program work. Artificial insemination can be a valuable management technique for improving a beef cattle breeding program. Success is limited by the manager's ability, determination, and patience.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, by the Cooperative Extension Systems at the University of Arizona, University of California, Colorado State University, University of Hawaii, University of Idaho, Montana State University, University of Nevada/Reno, New Mexico State University, Oregon State University, Utah State University, Washington State University and University of Wyoming, and the U.S. Department of Agriculture cooperating. The Cooperative Extension System provides equal opportunity in education and employment on the basis of race, color, religion, national origin, gender, age, disability, or status as a Vietnam-era veteran, as required by state and federal laws.
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Second edition; December 2006 Reprint