32 Artificial Insemination

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Objectives

- **Discuss the importance of artificial insemination training.**
- **Discuss heat detection and its aids.**
- **Discuss methods of artificial insemination.**
- **Introduce methods of semen handling.**

Various technologies are available to both the purebred and commercial beef cow-calf producers to enhance the efficiency, productivity and profitability of their operation. Artificial insemination (AI) is one of those reproductive technologies that can be profitably incorporated into the breeding program and used in both heifers and cows. Although AI has been commercially available since 1938, when the first AI organization in the U.S. was established, it is underutilized in the U.S. beef herds. According to the most recent USDA data, approximately 8% of cow-calf producers in the U.S. incorporate AI into their breeding program. Common reasons beef cattle producers give as to why they have not implemented AI into their breeding program is the labor, time required and/or cost. The advantages of incorporating an AI program into the beef herd breeding program are numerous. One of the main reasons a cow-calf producer might implement an AI program into their breeding program is to take advantage of the commercially available semen from proven, genetically-superior sires normally too expensive to acquire as a resident herd sire. Other advantages include:

- The ability to breed more females at one time to a given sire.
- A reduced investment in resident herd bulls due to the reduced number of bulls needed in the herd.
- The enhanced genetic value in the replacement heifers retained in the herd.
- An increase in bio-security by controlling disease transmission.
- The selection of gender by using sexed semen; the early identification of reproductive problems (freemartins, non-cycling cows, etc.) and when combined with estrous synchronization, a shorter calving season can be achieved, resulting in a more consistent, uniform calf crop.

A successful AI program requires attention to detail in all areas of herd management. Many managerial decisions relative to feeding, facilities, fences, corrals, equipment and sire selection will be necessary. Sound health and nutrition programs (cows in good body condition) are requirements of any successful breeding program, but are absolutely essential for a successful AI program. Additional areas in which management expertise must be exerted for a successful AI program include estrus (standing heat) detection, artificial insemination technique, proper semen handling and semen tank management.

Estrus (Standing Heat) Detection

The most limiting factor in AI programs is the proper detection of cows or heifers in estrus or standing heat. Estrus, or standing heat, is the period of time occurring during the estrous cycle (every 18 days to 24 days) in sexually mature, non-pregnant heifers or cows when they are receptive to mounting activity by the bull or other animals in the herd. Estrus behavior (cows standing to be mounted by other herd mates) is the only external sign when ovulation may be occurring and cows should be artificially inseminated. As sperm are usually fertile for 24 hours to 30 hours after insemination and the ova (egg) have a fertile life of eight hours to 10 hours, proper timing of insemination depends largely on effective heat detection and is critical for achieving high pregnancy rates. Table 32.1 illustrates the effect of estrus detection rate on pregnancy rate.

For a successful AI program, the producer needs to achieve a high percentage of pregnancy, requiring good estrus detection.

Heat Detection Requires Observation

The unquestionable sign of estrus or standing heat is that the cow or heifer in estrus permits other herd mates to mount her while she remains standing. An animal moving

Table 32.1. Effect of estrus detection rate on pregnancy rate.

Estrus detection rate	55%	60%	65%	70%	75%	80%	85%	90%	95%
Conception rate	70%	70%	70%	70%	70%	70%	70%	70%	70%
Pregnancy rate	38.5%	42%	45.5%	49%	53.2%	56%	59.5%	63%	66.5%

Adapted from George Perry, fact sheet 921B.

away in response to an attempted mount by another animal is either just coming in to or going out of standing heat and further observations are needed to confirm the correct interpretation. Usually, the animal in estrus is restless and often will mount and ride other animals in the herd. However, individuals that mount or ride other animals may not necessarily be in estrus; only those remaining standing for mounting are in estrus.

The most productive means of determining which cows or heifers are in estrus is to conduct visual observations for standing heat at a minimum of two times a day for a minimum of 30 minutes at early morning and late evening. Preferably, these times need to be 12 hours apart and for consistency, performed by someone designated to be in charge of heat-detection and records information including animal identification, time of observation and location of all mounting activity. More frequent observation also may be beneficial, if practical (for example, noon and midnight). The detection of standing heat in cattle while sitting in the feed truck, or while cattle are eating at the feed bunk or hayrack is difficult because hungry cattle often are more interested in feed than each other. Table 32.2 describes the percentage of cows showing signs of standing heat at different times of the day.

The largest percentage of cows exhibit signs of standing heat at the least convenient time for accurate heat detection (6 p.m. to midnight and midnight to 6 a.m.). This is a major cause of heat detection inefficiency. Many of the cows that experience a standing heat from midnight to 6 a.m. can be observed as having secondary signs of heat at the time of normal heat detection on the previous evening.

Table 32.2. Time of day when cows exhibit estrus.

Time of day	*Cows exhibiting estrus (%)*
6 a.m. to noon	26.0
Noon to 6 p.m.	18.1
6 p.m. to midnight	26.9
Midnight to 6 a.m.	29.0

George Perry, Fact Sheet 921B

Estrous synchronization will aid in the accurate detection of standing heat and shorten the number of days that heat detection must be performed (learn more about estrous synchronization in chapter 31).

Secondary Signs of Estrus

Secondary signs of standing heat that a producer may observe include:

1. A willingness to mount other cows, even though neither cow may be willing to stand for the mount.
2. A roughened tail-head where the hair on her tail-head could be standing up or completely missing, which is evidence that the cow has been ridden by other animals or other animals have tried to mount.
3. Dirty streaks or marks on lower hips, sides or shoulders as the forefeet of rider animals may leave traces of mud or dirt on the sides and hips of cows or heifers in standing heat. Both sides of the animal must show signs of being ridden, since an animal cannot be ridden and marked on only one side.
4. Restlessness, nervousness, standing head to tail, circling, head butting, pacing, sniffing and licking other animals and resting their chins on the back or hip of other animals all may be indicative of a cow about to exhibit estrus.
5. The grouping together of animals. Animals coming into estrus usually will congregate into small sexually active groups. Whenever a small group of animals gather together, it should be watched closely for animals in standing heat.
6. A clear mucus discharge can be observed hanging from the vulva or smeared on the pin-bones or rump by the tail of an animal in estrus.
7. A bloody discharge often appears two days to three days after the end of estrus, which usually indicates a missed heat and should be recorded to observe this animal for a return to estrus in 18 days to 24 days.

None of these secondary signs alone is a positive determination of estrus. Standing to be mounted by a bull or another cow/heifer is the only conclusive sign that an animal is in estrus and ready to be inseminated (Table 32.3).

Table 32.3. Secondary signs of standing heat.

Six to 19 hours before standing heat	*During standing heat (can last from 6 to 24 hours)*	*After standing heat (up to 10 hours)*
Will not stand to be ridden	Stand to be ridden	Will not stand to be ridden
May be vocal and smells other cows	Nervous and restless	Clear mucous discharge
Nervous and restless	Congregates and rides other cows	
Attempts to ride other cows	Vulva is moist, red and slightly swollen	
Vulva is moist, red and slightly swollen		

Estrus Detection Aids

Several different types of aids for the detection of standing heat are available for producers implementing AI programs. Estrus-detection aids (and estrous synchronization protocols) can greatly increase the likelihood of detecting cows or heifers in standing heat; however, these are just aids and are not substitutes for visual observation.

These types of aids include chin-ball markers placed on a marker animal such as an androgenized cow or a deviated and vasectomized teaser (gomer) bull. The chin-ball marker consists of a bowl-type reservoir filled with paint with a spring-loaded ball valve, similar to a ballpoint pen. The marker is strapped underneath the chin of the marker animal. When the marker animal mounts and rides another animal, the chin-ball marker is activated (the ball valve is depressed) and paint markings are left on the animal's back or rump area (different colors of paint are available). The producer must learn to interpret these paint markings, since paint markings also can be left when the marker animal rests its chin on another animal's back or rump area.

Several types of commercial mounting-activity detectors are available to the producer to aid in the detection of standing heat. These devices are glued (or contain an adhesive) to the rump area, just forward of the tail-head of the cow or heifer suspected to be in estrus in the near future. These detectors rub off, causing a visual color change to the pad due to a dye capsule releasing dye through a pressure valve and lighting up when a switch is compressed, or sending a signal to a computer when pressure is exerted on a transponder button. A prolonged pressure (usually three seconds) from the brisket/chest area of the mounting animal will "activate" these detectors. Detectors will be more effective in areas with little or no low-hanging tree limbs, brush or back-rubbing devices, since false readings can occur. These different types of detectors will vary in price and the producer must learn to interpret the results of the type of detector utilized.

Tail-head chalking is an economical estrus detection method used by many dairies in the U.S. An oil-based paint stick is available at most farm and ranch supply stores and in a variety of colors. The paint stick is rubbed on the tail-head from anywhere between the hook or hip bones back to and including the corner where the tail begins its vertical decent. The oil-based paint stick is relatively rain resistant and is unlikely to be rubbed off in low-hanging tree limbs or brush. After a week to 10 days, it will likely take on a flaky, crusted appearance as it dries. When the cow or heifer is in standing heat and being ridden repeatedly, the chalk will be mostly rubbed off. When a cow or heifer is coming into standing heat and is trying to be mounted by other animals and is not standing completely, the tail paint (chalk) will be slightly smeared with the hair and chalk being ruffled forward with a feathered appearance. When those conditions are observed, the cow or heifer needs to be monitored closely. Reading the chalk strip is not hard, but does require close observation and practice for proper interpretation. Used mainly in dairies, electronic activity monitoring systems are available to detect estrus.

The pedometer, which measures steps taken by the animal, is used along with a computer to monitor the cow's behavior pattern, activity, rest time and restlessness. Animals in estrus usually are restless and often increase their physical activity and may walk long distances. Pedometers establish a base-line of normal activity and using that base-line, a formula calculates an increase or a decrease in activity. The most recent electronic system marketed for monitoring physical activity associated with estrous behavior contains a microprocessor and a three-dimensional accelerometer. Accelerometers measure motion in three dimensions: side to side, up and down and front to back.

The producer needs to remember that no estrus detection system is fail-safe. They should be aware of the advantages and disadvantages of the system of estrus detection incorporated into the breeding program being considered.

The Timing of Artificial Insemination

The average interval from the onset of estrus or standing heat to ovulation in the cow or heifer has been shown to be approximately 32.0 hours (± 4.7 hours), with the average interval from the end of estrus to ovulation being approximately 20.6 hours (± 6.4 hours). The interval from the onset of estrus to ovulation is not related to the duration of standing heat. Maximum fertility for artificial insemination occurs when cows or heifers are inseminated during the last half of standing heat; more so, nearer the end of standing heat. The deposition of semen 10 hours to 12 hours before ovulation allows the sperm cells to go through a process known as capacitation — which is the physiological changes the sperm cells must undergo to have the ability to fertilize the egg. Once ovulation takes place, the egg travels very rapidly to the site of fertilization in the oviduct. The fertile life of the egg is shorter than that of the sperm (Figure 32.1). Fertility decreases slightly when cows are bred a few hours on either side of this target time period and marked decreases in fertility are seen when breeding occurs more

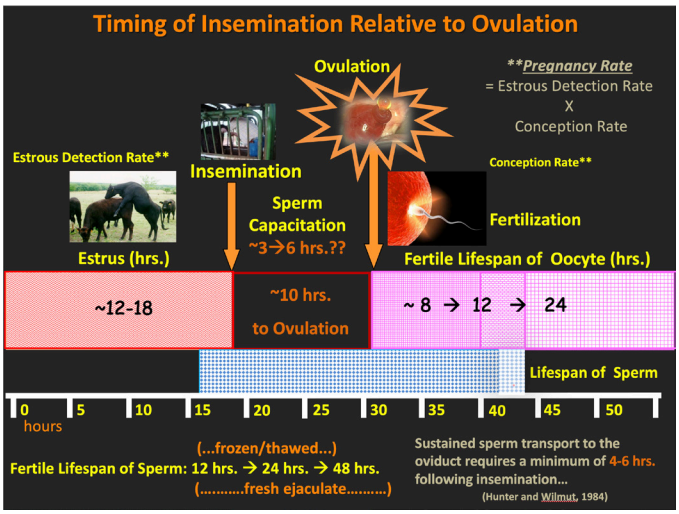

Figure 32.1. Illustration of the relationship among duration of estrus (standing heat, duration of the sperm lifespan, length of capacitation, duration of fertile lifespan of sperm and time of ovulation and duration of oocyte lifespan).

than 12 hours away from the end of estrus.

A guideline proven to work well for the timing of AI is often referred to as the a.m./p.m. rule (Table 32.4). At the end of the morning estrus detection period, animals detected in estrus the prior evening are bred. At the end of the evening estrus detection period, those observed in estrus that morning are bred. Acceptable pregnancy rates are found following the practice of inseminating cattle approximately 12 hours after the first observed standing heat. However, it is essential to remember the presence of fertile sperm in the oviduct must coincide with the time when the oocyte (egg) is viable (8- to 12-hour period following ovulation). Insemination too soon following detection of estrus, can decrease the probability that viable sperm are present at ovulation. However, insemination too late, relative to detection of estrus, may result in the oocyte dying before the sperm complete capacitation. When the onset of estrus is accurately determined by 24-hour electronic heat detection, insemination of heifers at 16 hours to 20 hours after the onset of estrus may optimize pregnancy rate (Wetteman et al.).

Semen Handling

Table 32.4. Using the a.m./p.m. rule for cow's first observed estrus.

First observed estrus	*Insemination time*	*Too late for optimum results*
Morning	Same evening	Next morning
Evening	Next morning	After 3:00 p.m. the next day

The quality of frozen semen when it arrives at the farm or ranch is determined by the bull and organization that processed it. Once it arrives, producers must take proper steps to ensure its viability. It is imperative to keep the canister, cane and unused semen straws as low as possible in the neck of the tank. A best management practice is to not expose semen to what has been identified as the danger zone, which is -112 F to -148 F (-80 C to -100 C). The critical temperature is approximately -112 F. Semen that is exposed to temperatures warmer than -112 F, even for a short period of time may be damaged. The extent of the damage depends on how long the semen is exposed to the elevated temperatures. Although it is easy to maintain frozen semen at a safe temperature, it is also easy to destroy it in a few moments of carelessness.

Shipper Tank

When shipping frozen semen, it is in a shipper tank referred to as a "vapor" tank, as liquid nitrogen itself is considered a hazardous material and cannot be in the tank during transport. When preparing a vapor tank for shipping, liquid nitrogen is actually poured into the tank, then absorbed into a special absorbent material lining in the tank. After a period of time, the liquid nitrogen not absorbed is poured back out of the tank leaving only vapor in the tank.

The temperature of a properly charged dry shipper should be approximately -301 F (-185 C) or colder. The "vapor" tanks keep the semen at a safe storage temperature during transport until the semen is either transferred back into another liquid nitrogen storage tank or thawed and used for insemination. Usually, a vapor tank will store semen safely for six days to eight days if unopened and the tank is shipped in an upright position. However, the holding time may be decreased for a tank shipped on its side or upside down. Frequent opening of the tank will result in a shorter holding time.

Tank Management

The semen storage tank consists of a tank within a tank, with an extremely efficient insulation system under vacuum between the inner and outer tanks. Because of the vacuum container construction, the temperature can remain at -320 F (-196 C), the temperature of liquid nitrogen, as long as at least 2 inches of liquid nitrogen is present in the tank. Technical advances in design and construction have produced storage tanks with a liquid nitrogen holding time of six months to nine months. Although semen storage tanks are well constructed, they still are susceptible to damage from mishandling. Semen tanks should be kept in clean, dry and well-ventilated areas. Avoid excessive movement of the tank. The inner chamber containing liquid nitrogen is suspended from the outer shell by the neck tube. Any abnormal stress on the neck tube, caused by sudden jarring or an excessive swinging motion, can crack the tube, resulting in vacuum loss from the outer chamber.

To increase holding time, keep the tank in a cool location away from direct sunlight. Avoid drafts from furnaces and outside air to help prevent excessive nitrogen evaporation. Make sure there is sufficient ventilation in the room to prevent possible suffocation of those nearby, which is caused by excessive nitrogen gas in the air.

Use boards or pallets to protect the tank from corrosion by keeping it elevated above concrete or wet floors. Corrosion of the outer shell will shorten the functional life of the tank and possibly cause failure. Pick a location safe from children and vandals, but do not hide the tank; it must be placed where it can be seen daily and monitored routinely for nitrogen level.

Finally, the liquid nitrogen level in the tank should be monitored regularly so it never goes dry. Always be watchful for a lid that has been left off and frost or sweat on the tank. Give particular attention to the neck and vacuum fitting. Frost indicates the vacuum insulation has been lost and liquid nitrogen has been or is evaporating rapidly. If you suspect this has happened, use a wooden yardstick to measure the amount of liquid in the tank. If the tank contains liquid nitrogen, the semen must be transferred to a good tank immediately. Should the tank be empty of liquid nitrogen, it is doubtful that the semen is viable and should be evaluated before it is used.

Retrieving Semen

Although the temperature of liquid nitrogen is -320 F (-196 C), there is a temperature gradient in the neck

Table 32.5. Temperatures found in the neck tube of a typical semen tank.

Location in necktube	*Range in temperature (F)*
Top	+36 to +54
1 inch from top	+5 to -8
2 inches from top	-41 to -51
3 inches from top	-103 to -116
4 inches from top	-148 to -184
5 inches from top	-220 t -256
6 inches from top	-292 to -313

of the semen storage tank (Table 32.5). The temperature in the neck of the tank is important because sperm injury occurs at temperatures as low as -112 F. This sperm injury is permanent and cannot be corrected by returning the semen to the liquid nitrogen. A rule of thumb many producers follow is to work below the frost line observed in the neck of the tank (Figure 32.2); however, the frost line has been shown to vary from -40 F to -184 F (-40 C to -120 C) between tanks. It is thought climatic conditions affect the "frost line" of the tank. The temperature in the neck of the tank also will become warmer as the liquid nitrogen level in the tank decreases. Sexed semen for commercial use is packaged in 0.25-milliliter straws instead of 0.5-milliliter straws. Furthermore, the concentration of sperm cells per straw of sexed semen is significantly lower than conventional semen. Although 0.25-milliliter straws containing sexed semen may be handled similarly to 0.5-milliliter straws, the smaller diameter makes them more sensitive to semen handling errors.

Best management practices to minimize thermal damage:

- Identify canister containing the desired semen. A semen inventory, keeping track of the location of each bull prevents unnecessary searching.
- Remove the canister from its storage position to the middle of the tank. Raise the canister just high enough in the neck region to grasp the desired cane of semen. **Keep the canister tops at a minimum, no higher than the frost line.**
- Grasp the desired cane and immediately lower the canister to the tank floor. Keep the cane as low in the tank as possible while removing the unit of semen. Use tweezers to remove the straw. If the straw is located in the upper goblet, bend back the top tab of the cane to a 45-degree angle. This will keep the straw from bending or breaking. **The straw should be removed within eight seconds from the time the canister is raised into position.**
- Immediately after the unit of semen is immersed in water, return the cane to the canister by raising the canister over the cane. Return the canister to its storage position.
- Any time it takes more than **eight seconds** to locate a particular cane, the canister should be lowered back into the tank to cool completely. **Never return a unit of semen to the tank once it has been removed from the cane.**

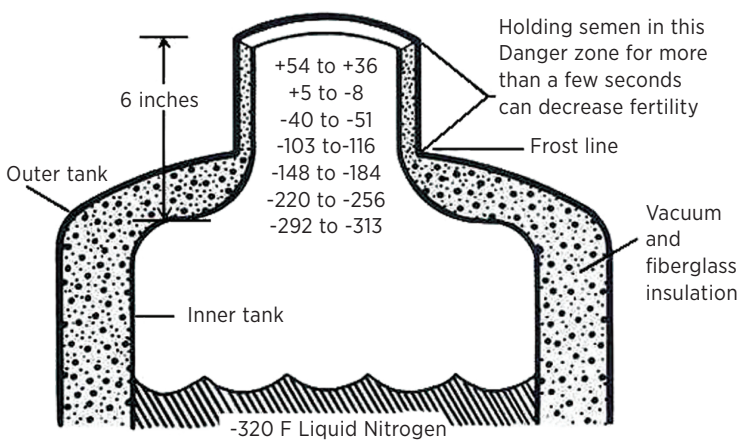

Figure 32.2. Cross-section diagram of liquid nitrogen tank.
(Adapted from American Breeder Service)

Semen Transfer Between Tanks

- Transfer of semen between tanks must be coordinated and rapid. Two people should be involved and tanks should be arranged side by side.
- Fill the tanks with liquid nitrogen before transfer, if possible.
- Have the appropriate canister in each semen tank in the center position.
- Transfer the canes quickly (within three seconds to five seconds). Never touch the units of semen with bare fingers.

Thawing Procedures

The correct thawing recommendation for semen in straws is not the same for all AI organizations. However, almost all organizations now recommend warm-water thawing of straws for 10 seconds to 60 seconds. For optimum results, follow the specific recommendations of the semen processor. Breeders may use semen from various AI organizations, but practice only one thawing procedure. The National Association of Animal Breeders (NAAB) has recommended that, when in doubt, 90 F to 95 F for a minimum of 40 seconds should be used as a universal thawing recommendation. Do not "pocket thaw" straws of semen unless recommended by the company packaging the semen. The pocket thaw should not be used for semen packaged in straws from other companies.

A major concern with warm-water thaw is the danger of cold shock when the straw is mishandled after thawing. Cold shock is the permanent injury to sperm caused by a sudden decrease in semen temperature after thawing. It occurs when semen is thawed, then subjected to cold environmental temperatures before reaching the cow. The severity of damage depends on rate and span of temperature drop. If precautions are taken to prevent cold shock, the advantage of warm thaw will be realized. Following are some thawing tips:

- Always keep insemination equipment clean, dry and warm.
- Use a thermometer to check the temperature of the warm-water thaw; do not guess at the temperature. Check the thermometer for accuracy at least every six months with a reference thermometer.
- Use an insulated water bath designed for thawing semen or a one-pint wide-mouth thermos deep enough to immerse the entire straw. Electronic thawing devices, which maintain water temperature accurately between 90 F and 95 F, are now available. These are convenient to use when breeding many cows at one time. Do not rely on the thermostat of the device to be correct. Always use a thermometer to double-check the temperature of water bath.
- Never thaw more than one unit of semen at a time. Breed cows individually, so thaw units of semen individually. Although research has shown that multiple straws can be thawed simultaneously, bulk thawing of semen should only be considered when a large group of synchronized cattle are to be inseminated. A general recommendation as to the number of straws that may be thawed simultaneously detracts from the overall importance of proper semen handling for successful AI. Straws thawed in bulk should be agitated slightly to keep them from sticking together.
- Gently shake the straw as it is taken from the tank to remove any liquid nitrogen that may be retained in the cotton plug end of the straw.
- Time the thaw with a watch to avoid guessing.
- When possible, use thawing recommendations of the AI organization from which the semen was processed. Otherwise, use NAAB's recommendation for 90 F to 95 F for a minimum of 40 seconds.

It is essential frozen semen is handled and thawed carefully and properly to obtain optimum results. It also is important to deal only with reputable, well-established AI organizations because their semen has been processed under standard, controlled conditions routinely evaluated.

During Insemination

One of the most frequent chances for semen damage is during transport to the cow. After thawing, the semen temperature must be maintained as close to 95 F as possible. Handling thawed semen and preparing the insemination rod should be done in a sheltered, preferably heated, area. Proper steps for handling semen include:

- While the semen is thawing, warm the insemination rod by rubbing it briskly with a paper towel. In cold weather, place the warm rod within clothing so it will be close to the body and maintain warmth.
- After the semen is thawed for the required time, dry it thoroughly with a paper towel to protect it from rapid cooling.
- Adjust the air space in the straw to ensure no semen is lost when the end of the straw is cut off. This can be done by slightly flicking the wrist while holding the straw at the crimp-sealed end.
- Transfer the straw to the rod and cut the tip of the crimp-sealed end of the straw squarely and through the air space. Only sharp scissors or a specially designed straw cutter should be used. Make sure to cut the straw "square" to achieve a good seal with the sheath.
- Wrap the assembled insemination rod in a clean, dry paper towel and tuck it within your clothing for transportation to the cow. Do not place the rod in your mouth or carry it uncovered in your hand.
- Inseminate the cow within minutes after thawing. The period of time between removing the semen from the tank and depositing the semen in the cow should not exceed 15 minutes.

Insemination Process

The recto-vaginal insemination process is used. Although not part of the female genital tract, the rectum (terminal portion of the large intestine) is an important organ to become familiar with, because your arm inside the cow will be working through this thin-walled tube. The rectum is 10 inches to 12 inches long and very stretchable. This is important to understand because it is through the rectum that manipulation of the cervix occurs during the insemination process. The anus serves as a valve between the rectum and the outside. A muscular ring (anal sphincter) keeps the anus closed. The gloved hand is inserted by forming the thumb and fingers into a cone tip and with a slight rotary motion, forcing it into the rectum. The anus is stretchable; hence, your hand and arm can easily slip into the rectum. Waves of peristaltic contractions will be encountered from the rectal wall. These often feel like rings. When strong, these contractions may block your hand from moving forward and make it difficult to manipulate the genital organs through the rectal wall. Judgment must be developed as to how much resistance to exert with the hand against these contractions so the animal will not be injured.

Sanitary Technique

Wash your hands. Inseminating cows is an invasion into the delicate uterine environment that is very conducive to growing bacteria. Bacteria on your hands could be transferred to your inseminating gun during the loading procedure. Likewise, thoroughly clean the inside edges of the lips of the vulva with a paper towel before inserting the insemination rod. If contaminants are carried into the uterus during insemination, these organisms could thrive and grow rapidly, resulting in metritis and infertility.

Semen Placement

The insemination process is a straight-forward process. However, since relatively few sperm cells will be used compared to a natural service by the bull, placement is critical. Semen should be deposited in the body of the uterus just in front of the cervix (Figure 32.3). One can recognize the proper site by the change in tissue consistency – from firm and hard in the cervix to soft and spongy in the uterus. To achieve the highest possible fertility rate, semen should be deposited at the very front end of the cervix. The internal (or

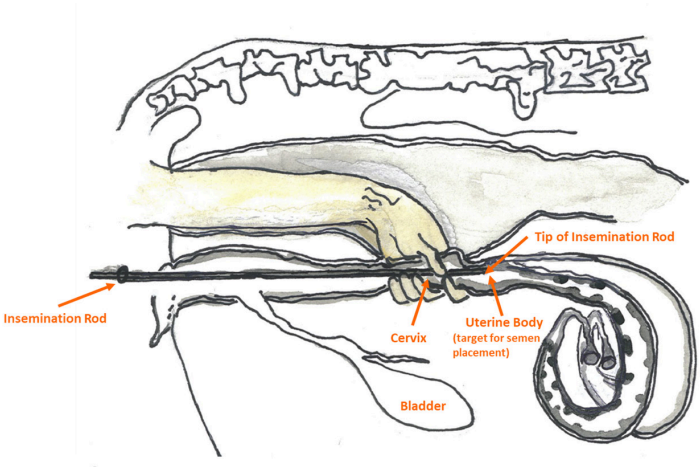

Figure 32.3. Placement for semen.

front) end of the cervix is often called the anterior cervical opening (os). Depositing semen at this location requires the use of a special device called a Cassou pipette, or AI gun. Steps of the process include:

1. Put on a clean plastic palpation sleeve and lubricate the glove and sleeve with a clean, nontoxic lubricant.
2. First gently clean rectum of manure, then gently insert arm into rectum by forming a cone with your fingers.
3. Thoroughly clean exterior of the vulva and surrounding area with clean paper towels.
4. Dilate the lips of the vulva by exerting slight downward pressure of the forearm in the rectum and backward pressure with the fingers just inside the rectum.
5. Insert AI gun as far as possible into the vestibule and vagina without touching the internal surface of vulva (point tip of A.I. gun upward while keeping track of gun with the gloved hand)
6. Pass the AI gun along the roof of the vagina until it reaches the cervix (avoid the suburethral diverticulum, a blind pocket just beneath the opening to the urethra).
7. Grasp the cervix through the rectal wall and guide the AI gun into the opening of the cervix with the aid of the thumb and little finger. The opening into the cervix protrudes back into the vagina. This forms a 360-degree blind pocket completely around the cervical opening. This pocket is referred to as the fornix vagina.
8. Apply gentle pressure and manipulate the cervix over the AI gun with a rotary movement of the wrist and movements of the fingers until penetration of the cervix (moving the cervix forward and backward to pass the annular rings may be needed).
9. Determine the length of the cervix and place the index finger at the uterine end of the cervix.
10. Move the AI gun forward through the cervix until feeling the tip bump the index finger. Make sure the location is not in the fornix vagina or caught between the cervical rings.
11. Slowly depress the plunger of the AI gun and deposit the semen in the uterine body.
12. Avoid pulling the A.I. gun backwards when depositing the semen because it may be deposited in the cervix and/or vagina.

In adequately restrained cattle and practice, this will take 30 seconds to two minutes. Passing an insemination syringe might not always be easy, because encountering natural obstructions may occur before semen deposition.

Reminder of Obstacles

The front end of the vagina forms a circular blind pouch where it joins the backward projecting cervix. This blind pouch is referred to as the fornix vagina and is usually from half-inch to 1 inch deep, surrounding the entire dome-shaped back end of the cervix. There will be other obstacles once inside the cervical canal. Firm, finger-like projections arranged in three to four circular rings extend into the canal. These cause the passageway to be crooked and contain blind pockets or dead ends. The circular blind pouch of the vagina and the winding cervical canal with its dead ends are the two major stumbling blocks for anyone learning how to artificially inseminate.

Next to estrous detection, semen placement error (by the technician) is most likely to affect fertility. Correct semen placement is very difficult to confirm in the field. It is impossible to check for correct pipette placement. The pipette position changes too easily. Post mortem tracts or examining culled cows inseminated with dye can be used to check semen placement after slaughter. Studies using dye deposition followed by slaughter have shown that up to 70% of the cows are inseminated incorrectly. The dye was placed in the vagina, posterior cervix, uterine horn or bladder. The target for semen deposition is the anterior cervical os, a difficult site to find. Inexperienced inseminators often do not pass the pipette far enough, or they pass it too far into the uterine horns. Since the body of the uterus is only half-inch to 0.75-inch in length, pipette passage 1 inch into the uterus results in most of the semen entering only one horn, effectively reducing conception. Semen deposition is often made too rapidly and semen takes the avenue of least resistance. If one horn is not as open as the other, it does not receive enough semen.

Take time while breeding a cow and depositing the semen. It only takes a few extra seconds to make sure semen is deposited correctly. The plunger should be slowly depressed during a five-second period, allowing the semen to flow slowly and evenly, divided between horns. In non-pregnant cows, walls of the uterus are soft and spongy. Insemination guns should never go beyond the front end of the cervix, because it is too easy to poke into or through the uterine wall. This could cause infection and perhaps even fatal peritonitis.

Experienced Technicians

Professional technicians are more successful at insemination than inexperienced owners or managers. Inseminators should periodically attend AI courses to improve or correct techniques. Selection of a qualified inseminator is an important element in the success of the AI program. While the insemination process is simple to

understand, it does require considerable manipulative skill. Companies selling semen often conduct three- or four-day training programs that provide individuals with sufficient skill to begin inseminating cows and heifers. However, newly trained individuals generally experience lower conception rates until they have inseminated a number of animals. Regular practice at inseminating is required to maintain high conception rates. In many localities, AI studs have trained inseminators who provide insemination service for a reasonable fee. Cattle operations where artificial insemination is routinely used often have a well-trained individual who may be available as a technician. Before producers make a decision whether to hire a trained technician or to train a member of the farm team, they should weigh the considerable cost of a reduced conception rate during the learning process against the fees paid for a trained technician.

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