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Maximizing Pregnancy Rates When Using Artificial Insemination

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Artificial insemination (AI) offers the opportunity to use semen from high-accuracy, genetically superior sires at a fraction of the cost of purchasing a herd bull of similar genetics. In addition, using estrus synchronization and AI can increase the number of calves born earlier in the calving season and increase weaning weights of calves.

A portion of the economic advantages resulting from implementing AI is related to the number of calves born in a herd from AI sires. The benefits are twofold: an immediate increase in sale value and, long-term benefits of infusing superior genetics into a herd.

Therefore, understanding and managing the factors that contribute to maximizing AI pregnancy rates can improve profitability in beef herds implementing AI. This publication will review how factors related to cows, bulls and those controlled by humans all contribute to the success of your AI breeding program.

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Cow Factors That Influence Success

Nutritional Status

Nutritional status leading up to the breeding season plays a major role in the attainment of pregnancy. Body condition scoring (BCS) is a method to evaluate nutritional status based on observation alone. The target BCS at the time of breeding is approximately 5 on a scale of 1 to 9 (1 = emaciated, 9 = obese).

The plane of nutrition is equally as important as body condition score. The ideal situation is to have cows on an increasing plane of nutrition and gaining body condition leading up to the time of breeding. Cows that calved in heavy condition and are losing BCS leading up to the breeding season likely will have difficulty becoming pregnant.

In addition to energy (which drives BCS), making sure that the females' protein, vitamin and mineral requirements are being met leading up to breeding season is important. A good time to start managing BCS of females is around the time of weaning - yes, six months prior to breeding - when the energy requirements and cost of putting extra condition on thin cows will be the least.

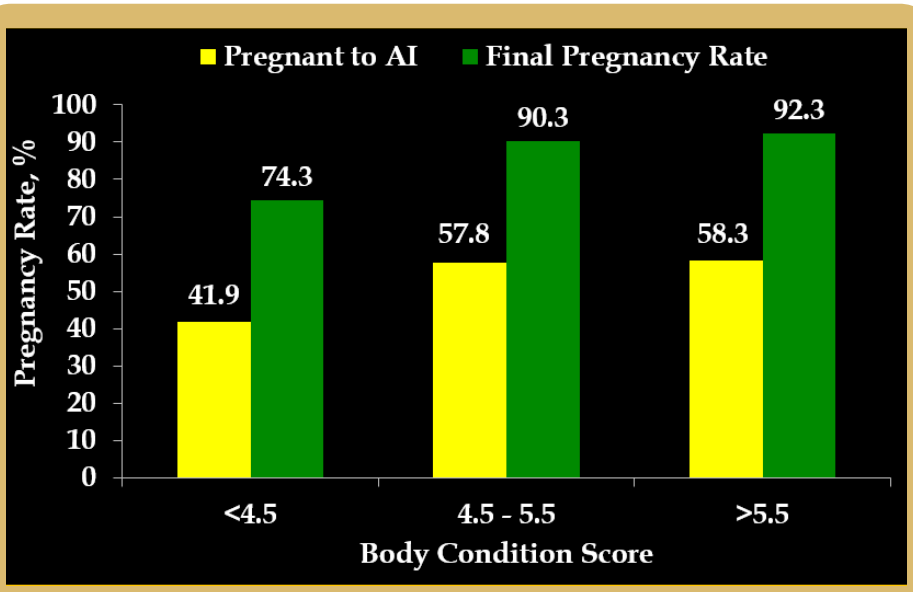


Figure 1. The impact of body condition score at the time of breeding on pregnancy rate with AI and season-ending pregnancy rates in beef cows from NDSU herds. (NDSU illustration)

Days Postpartum

Days postpartum (DPP) refers to the number of days since an animal has given birth and is a key indicator of potential reproductive performance. After giving birth, a period of recovery is necessary before females can resume having normal and regular estrous cycles.

The energy demands needed to repair the uterus and supply milk to a growing calf may not be met by feed intake alone. Therefore, fat stores in the body are mobilized to meet the body's energy demands (also known as a state of negative energy balance).

As the DPP increase, the likelihood of a cow having gone through the uterine repair process and returned to a positive energy balance and normal estrous cycles also increases. In an ideal situation, cows should be at least 45 DPP at the time of breeding.

Reproductive Tract Scores in Heifers

Reproductive tract scores (RTS) in heifers are assigned based on size of the uterus and structures in the ovaries, and can be used to eliminate heifers with poor breeding potential and identify any freemartin heifers. As RTS increase from 1 to 5, the proportion of females likely to conceive with AI also increases (Figure 2).

Scores should be assigned about 45 days in advance of the breeding season to allow time for any necessary changes to the nutritional program. Consider removing all RTS 1 heifers from the replacement pool. For optimal fertility with AI breeding, 50 percent of all heifers should have an RTS of 4 or 5.

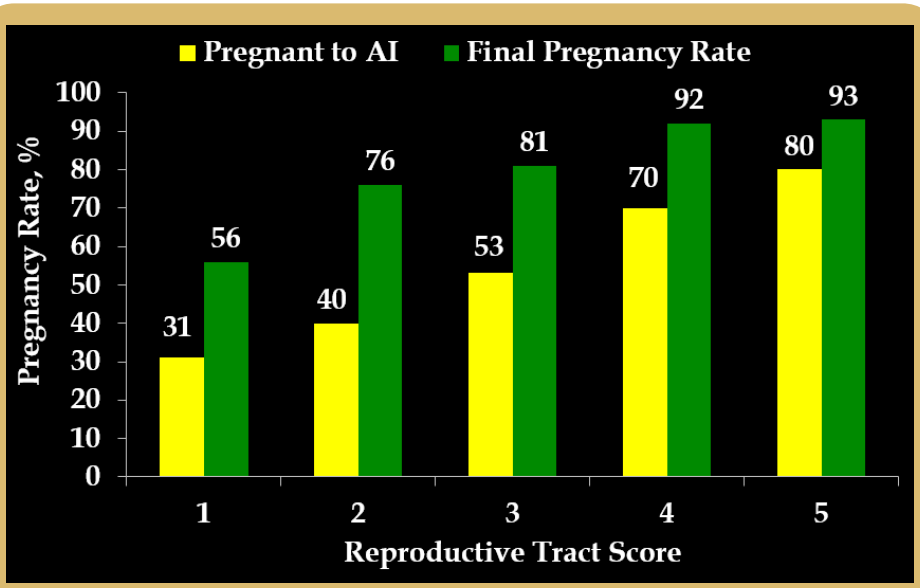


Figure 2. The impact of reproductive tract score on pregnancy rate with AI and season-ending pregnancy rates in beef heifers. (Adapted from Holm et al., 2009. Journal of Animal Science)

Health/Vaccination Status

Prior to the breeding season, females should be in good overall health. Several types of viruses and bacteria can cause reproductive failure. For example, bovine viral diarrhea virus (BVDV), infectious bovine rhinotracheitis (IBR) and a host of *Leptospira* bacteria all have been associated with poor reproduction through reduced pregnancy rates, abortions or stillbirths.

Pre-breeding vaccines help protect cattle against some common sources of embryonic/fetal loss and should be administered according to the manufacturers' label recommendations (typically at least 30 days prior to breeding, avoiding vaccine exposure to sunlight, and closely controlling vaccine temperature during storage and administration). In cases where vaccines require a booster, plan ahead to ensure the booster dose is administered in advance of breeding.

Administering vaccines close to the time of breeding (off-label) poses a very real danger that the pregnancy rate with AI could be compromised, especially in the case of modified-live vaccines. Some vaccines can cause short-term infections that may harm oocyte/embryo development or temporarily disrupt normal reproductive function during the time when an animal's immune system is responding to the vaccination.

Note that working events in many of the estrus synchronization protocols coincide with times when vaccine administration would be off-label, and vaccinating at these times could reduce pregnancy rates with AI dramatically.

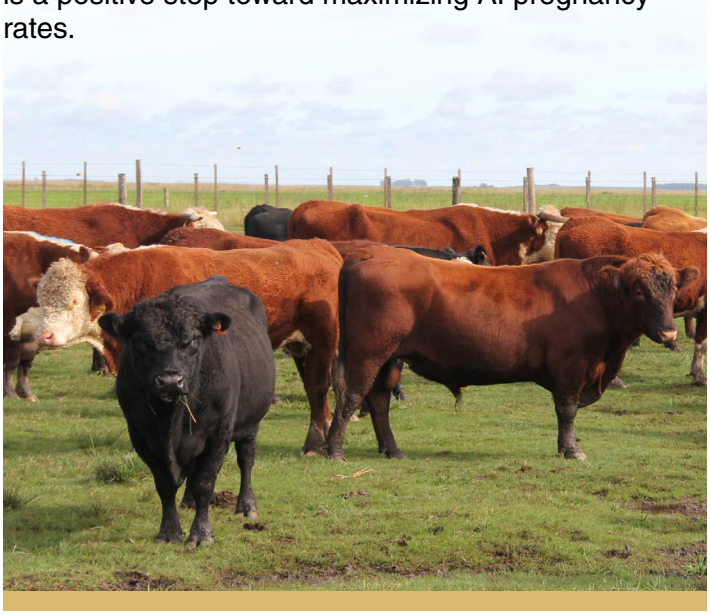
Bull Factors that Influence Success

Although AI takes many of the traditional bull factors (age, stocking rate, libido, etc.) out of the breeding equation, we still have to recognize that differences in fertility exist among AI sires. Because of the extensive recordkeeping systems in the dairy industry, several AI companies routinely publish information regarding conception rates of available AI dairy sires.

Differences in fertility among beef sires also exist, but large-scale sire fertility tracking in the beef industry is inhibited by two items: 1) the beef industry does not have recordkeeping infrastructure comparable to the dairy industry to track sire fertility, and 2) utilization of AI is much lower in the beef industry, compared with the dairy industry, and good prediction of sire fertility requires pregnancy results from a large number of breedings.

Nevertheless, at the time this publication was created, several AI companies were exploring methods to report fertility of frozen beef semen, and some companies were beginning to publish sire conception rate data on a portion of their beef bull battery. According to one advertisement, selecting a bull with the greatest fertility could yield estimated pregnancy rates that are 10 percent greater than those of a bull with the least fertility estimates.

Consult with your semen supplier about which bulls consistently have generated superior fertility in the AI scenario you plan to implement (fixed-time AI, heat detection, etc.). Consistently identifying and using bulls that produce semen of high fertility in AI settings is a positive step toward maximizing AI pregnancy rates.



People-controlled Factors That Influence Success

People control many of the things that need to occur to maximize the success of an AI program. Once a clear plan to implement AI has been established, your focus must turn to perfecting the necessary tasks required at each step of the process, working with the weather and managing cattle after breeding.

Perfecting Necessary Tasks

Handling cattle: Synchronization protocols require producers to work cattle from two to four times to accomplish AI breeding, with a majority being worked three times. From experience with vaccinating or pregnancy checking cows, producers know how well their herd moves through their working facilities. Each person working cattle always should practice calm, low-stress handling techniques through adequate facilities, or stress may lead to poor results. Whenever possible, avoid anything that can stress cattle, including loud noises, aggressive dogs, aggressive people, gunshots, roping for fun and excessive use of hotshots.

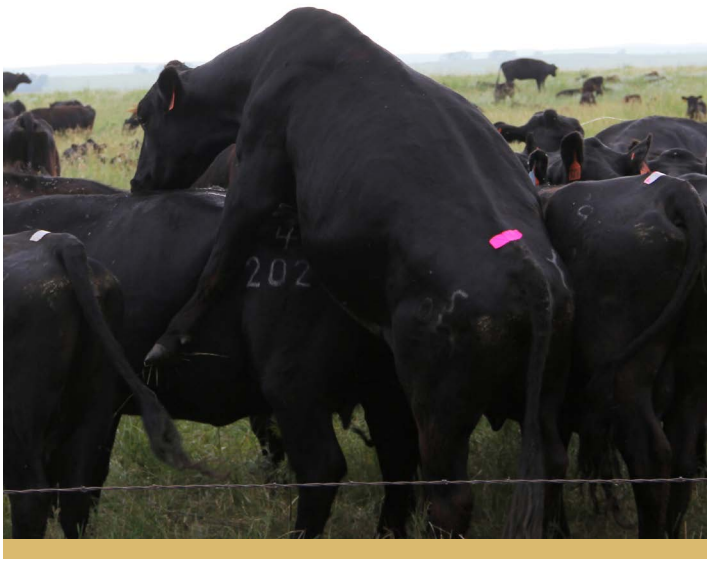
Consider acclimation: Acclimating cattle allows them to become accustomed to working facilities and handling practices that will be used during the synchronization and AI process. Moving cattle calmly through facilities several times in advance of the breeding season can reduce the stress of subsequent handling events and improve cattle temperament, and may increase pregnancy rates.

Heat detection efficiency: If producers are using a protocol that requires heat detection, spending adequate time detecting estrus and correctly identifying that animals are in estrus is imperative. In general, the more time spent on estrus detection, the greater the proportion of animals that will be identified in estrus. Following old rules of thumb of 30 minutes of estrus detection in the morning and the evening can result in a proportion of estrus females not being identified.

Observation of greater duration (up to two hours) and frequency (morning, noon and night) is required for optimal results. If facilities allow, move cattle detected into a pen or pasture away from nonestrus cattle. Estrus detection will be easier in the remaining animals and, once the very active estrus females are removed, you may observe estrus in females that have more subtle expression of estrus.

Several types of estrus detection aids are available to assist producers with identifying estrus females. Estrus detection aids are placed on the tail head of females and are activated by the pressure applied when other animals mount an estrus female. Producers then can observe changes in the estrus detection aid (change in patch color or ruffled tail head paint) or electronic signals as possible signs of estrus. In addition, estrus detection aids can be used as the foundation of target fixed-time AI breeding programs to maximize pregnancy rates.

Recent research efforts have highlighted an advantage of delaying AI in females with nonactivated estrus detection patches at the time of normal fixed-time AI. In the population of cows with nonactivated patches, pregnancy rates were improved from 5 to 10 percent when insemination was delayed until 15 hours after the normal appointment breeding time.



Compliance to protocols: Estrus synchronization to facilitate AI requires precise timings of injections and inseminations; therefore, producers should have a solid plan in place before executing a protocol to avoid missing a critical time point.

Also, ensure cleanliness and appropriate administration of all synchronization products. Maintain cleanliness of CIDR applicators, rinse CIDRs and applicators with chlorhexidine or similar disinfectant before insertion, and ensure cleanliness of the females' vulva/perianal region before CIDR insertion.

In confined cattle, consider cutting CIDR tails flush with the vulva to avoid removal by other cattle. If a CIDR tail is not seen when females are presented for CIDR removal, place your gloved hand into the rectum (similar to when AI breeding) and ensure you cannot feel the CIDR. When administering synchronization products intramuscularly, use deep I.M. injection in the neck with 18-gauge 1½-inch needles to prevent backflow of the product.

Each task at each working event is required for successful synchronization, and impacts of noncompliance (missed cattle, improper injections, CIDRs left in, etc.) are additive. If every task is completed correctly 90 percent of the time and a protocol requires three working events, the end result would be that 72.9 percent of females were synchronized correctly (.90×.90×.90 = 72.9 percent). Strive for complete compliance when executing tasks to limit negative additive effects.

Semen-handling and insemination technique: To ensure the highest possible fertility, we must start with high-quality semen that has been handled correctly. Semen quality can be compromised by damage caused at any step of the collection, handling, freezing, storing, thawing or insemination procedures.

Purchase semen from a reliable source such as Certified Semen Services (CSS) labs, which have strict standards for semen quality and processing, and also require evaluations post-thaw.

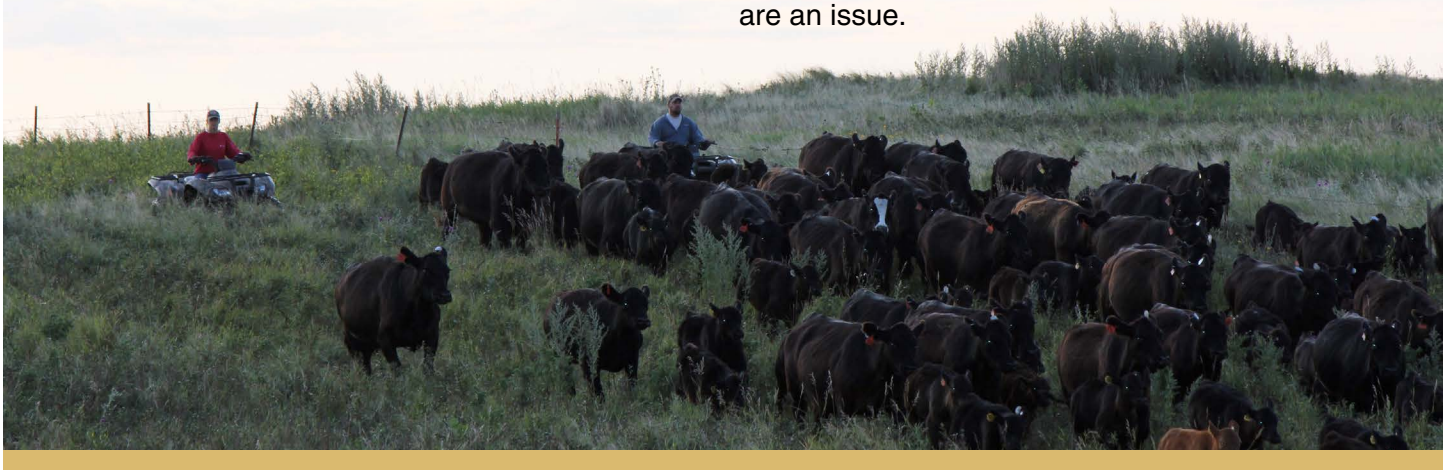
One study showed that semen shipped from sources other than AI companies had a four times greater chance of being rated as unacceptable (greatly reduced semen quality), compared with semen shipped directly from AI companies. With either source, be sure that semen has been kept under strict quality-control standards and monitoring systems.

Once semen has arrived at the ranch, transfer the semen from dry shippers to storage tanks as soon as possible. Pay close attention to how long semen is exposed to air temperature, and make sure storage tanks have plenty of nitrogen and are kept in a safe place.

A general rule is to keep any semen exposure to ambient temperatures to *less than 8 seconds* during tank transfer or when taking semen out of the tank to thaw. Impacts of air exposure on semen can affect not only the semen being used to inseminate, but also the semen that is being put back into the tank. **Do not** use dry shipping tanks for breeding; always transfer to a storage canister.

Although an extensive guide for semen handling is beyond the scope of this publication, note that thawing semen, loading AI guns and insemination all need to be done correctly, and cleanliness is imperative.

Pregnancy rates can vary greatly by technician, so to maximize pregnancy rates with AI, make sure everyone doing the breeding is proficient at AI and has sufficient experience to breed the number of cattle required within the window of time required. Backup technicians are also a good idea in case of injury to a primary technician. Professional AI services are available if AI proficiency, experience or time limits are an issue.



Working With the Weather

Adverse weather (heat, cold, excess precipitation, etc.) is a stressor that can impact the success of an AI program negatively. Although we cannot control it, we need to understand the impacts that weather can have and schedule our activities in anticipation of these impacts.

An example of the negative impacts of heat and humidity at different times of the day on pregnancy success is found in Table 1. In this example, cattle were gathered after sunrise (about 6 a.m.) and breeding started after all cows were sorted from their calves. Cows that were bred earlier in the morning had greater pregnancy rates than those cows that remained in the holding area and were bred in the late morning.

Trends such as midsummer heat and midwinter cold are easy to anticipate. If working on hot days, early morning or late evening may be cooler and more preferable times to work cattle. Start gathering, sorting and breeding cattle for large mid-July AI projects as soon as daylight permits (a 6 a.m. sunrise easily enables a 5:30 a.m. start for gathering).

If labor and facilities permit, consider assigning several people to tasks of sorting cows from calves, and have others designated to begin breeding as soon as the first cows are sorted off.

During hot summer periods, the body temperature of cows in the early morning is the lowest it will be throughout the day. If cattle working is required during peak periods of sunlight and heat, provide shade and water when possible. Also, provide ample space for cattle to spread out in staging areas, and ensure cattle spend as little time as possible in closely confined portions of working facilities.

With herds that are bred during cooler times of the year, our focus may shift from concerns about hot temperature to managing freezing conditions, or to optimizing the use of available daylight to complete cattle work.

In all cases, however, prepare for the damaging effects that precipitation (rain or snow), bright sunlight, wind, etc., can have on semen quality, cattle movements and labor forces, and have a plan to counter each. The most time-sensitive window is from CIDR removal to GnRH administration and AI, so pay close attention to forecast models and make small adjustments to working events if needed.

If major changes to protocols are needed in light of weather, seek technical advice for the best plan of action. Possible action steps are to work smaller groups of cattle during multiple days, provide extra labor to move and breed cattle, provide temporary lighting to work during darkness before a storm, or bring in extra facilities (breeding barns, temporary alleys, etc.) to optimize cattle flow and efficiency of the breeding project.

Table 1. Effect of time of day and temperature humidity index on pregnancy success in beef cows

	Breeding Group	
Item	**Early**	**Late**
Start time	7:45	9:52
End time	9:50	noon
Temp. humidity Index*	75.9	78.7
Number pregnant	32 of 52	20 of 52
Pregnancy rate, %	61.5	38.5

* Temperature humidity index at 72 = physical signs of heat stress; at 86 = severe heat stress

Managing Cattle After Breeding

After insemination, you must consider and address additional management factors to see maximum pregnancy rates. Embryonic loss can result from stress to cattle after breeding. Before the fifth day, the oocyte is protected in the oviduct of the reproductive tract and less sensitive to stress, compared with an embryo in the uterus.

Between days five and 42, the embryo is in the uterus and therefore is more sensitive to changes in the uterine environment that could result from the stress of transportation. After day 42, a small chance for pregnancy loss still exists, but it is much less likely than between days five and 42. Whenever possible, transport cattle from day one to four after AI or delay shipment until 45 days after AI.

Heat stress in cattle during this critical window also can impact embryonic loss and pregnancy rates. If forecasts models predict pending heat stress, consider taking steps outlined in NDSU Extension publication *AS1615, "Dealing With Heat Stress in Beef Cattle Operations."*

Diet and environmental changes immediately post-breeding also can impact rates of pregnancy with AI. Moving heifers from a dry lot setting to a pasture immediately after breeding can cause a reduction in pregnancy rates. That's likely due to changes in nutrition and changes in activity level from dry lot to pasture. If heifers only have been in a dry lot setting, movement to a grazing system could cause weight loss and decreased pregnancy with AI, compared with heifers that have previous grazing experience.

In addition, offering pasture supplements to cattle for 45 days after moving them from dry lots to pasture immediately after breeding can result in greater pregnancy rates, compared with cattle moved at breeding and not supplemented. Take action to maintain a proper (nutritious and toxin-free) diet throughout pregnancy, and avoid sudden changes to the diet or stresses to cattle.

Many factors can influence pregnancy rates with AI They include cows, bulls, people and things beyond our control. Paying attention to detail in each of these areas as an AI project progresses is imperative to maximize pregnancy rates and the number of AI calves born in an operation. In addition, a thorough evaluation of what went right, what went wrong and how it can be done better after each AI project will help achieve desired results in the future.

All photos by Carl Dahlen, NDSU.

For more information on this and other topics, see **www.ag.ndsu.edu**

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