Understanding and Diagnosing Pregnancy Loss in Beef Cattle

K-STATE Research and Extension

In beef cattle, fertilization rate is generally considered to be near 100%; however, not all fertilized eggs make it to term. If pregnancy loss occurs before day 42 of gestation, it is referred to as embryonic loss. The greatest loss occurs early in the embryonic period. After that point and through the full term of gestation, the loss is a fetal loss or an abortion.

Figure 1 shows common research measurement points and estimated loss through calving (Pohler, 2019). After a single mating, fertilization will occur in 95 of 100 cows, but only 60 will calve. Much of the early embryonic loss occurs before day 20 and may be due to poor oocyte quality (egg before fertilization) or some type of uterine insufficiency. The lack of a method to diagnosis pregnancy before a return heat (about day 21 post breeding) has slowed research in this area.

In the best case, a cow that experiences early embryonic loss will have a calf that is 21 days younger and roughly 42 pounds lighter at weaning. If this happens to 25% of cows in one estrous cycle and the 42 pounds in lost weaning weight is valued at $1.50 per hundredweight it represents a loss of $15.75 per cow. While most of these cows would conceive later in the breeding period, the loss in calf weight remains.

The other end of the cost spectrum for pregnancy loss is a cow diagnosed pregnant in mid-gestation that fails to calve. Annual feed costs (more than $500 per head, 2014-2018 KFMA summary) are incurred but not offset by income from a weaned calf. The timing of the losses and number of females affected will determine the total economic loss to the producer. It is not reasonable to expect all losses can be eliminated, but it is important to know what is considered normal and how to troubleshoot.

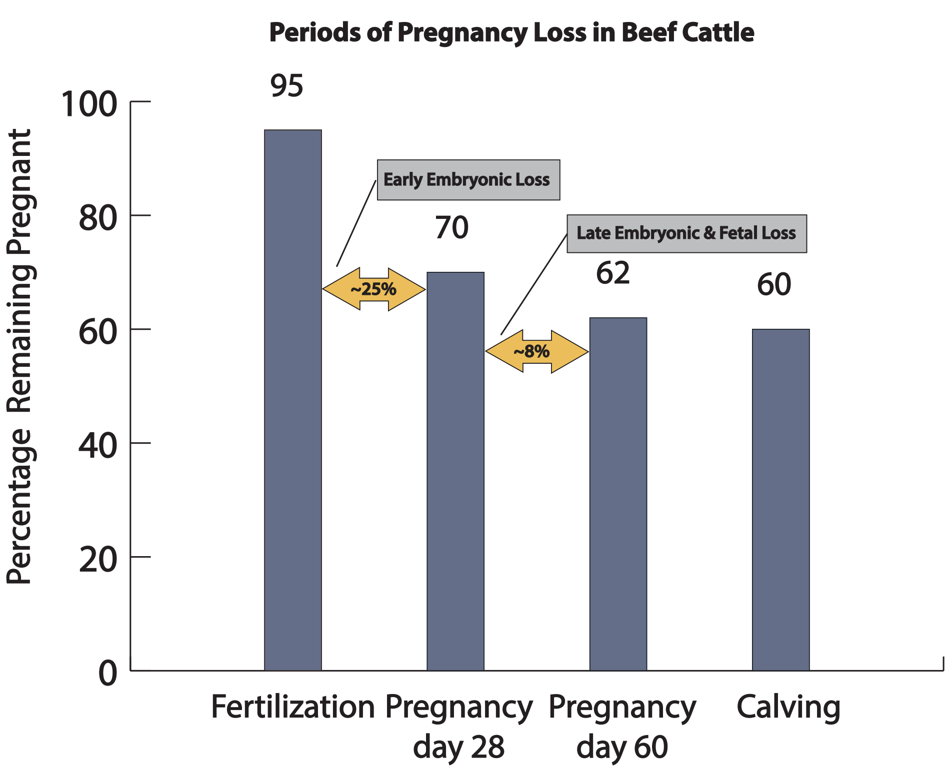

Figure 1. *Common research measurement points and estimated loss through calving.*

Definitions and Benchmarks

Pregnancy rate is typically defined as the number of pregnant females out of the total number of females exposed to bulls with a given time period (AI pregnancy rate, season-long pregnancy rate). **Conception rate** is the number of pregnant females expressed as a proportion of those inseminated. In natural service settings, conception rate is rarely known.

Benchmark data can serve as a baseline for average performance. The CHAPS database (updated 09/28/2018) from North Dakota State University shows an average breeding season pregnancy rate of 93.7%. Of those, 63% calved in the first 21 days of the calving season. The length of the breeding season is not part of the data set, but 96% of calves were born by day 63 of the calving period.

Similar data are not available for yearling heifers. Oosthuizen et al., 2021 reported treatment means ranging from 80% to 84% for 18 locations representing 2,448 heifers with a range of season-long pregnancy rates of 68% to 90% (mean of 82%) for individual locations. A lower pregnancy rate in heifers compared to cows may reflect difficulty in identifying subfertile heifers before the first breeding season.

When shorter breeding seasons are used, lower pregnancy rates are expected to a point. Pregnancy rates of 80% or better have been achieved in well-managed herds in a 30-day (Deutscher et al., 1991) or 32-day breeding period (Grings et al., 2005) that used estrus synchronization to achieve two breeding opportunities during that period.

Embryonic Loss

Much of the early embryonic loss goes undetected as the embryo and any membranes are resorbed and no other signs of loss exist, and the female returns to estrus at a normal interval (about 21 days). An interval from breeding to a return to estrus of 30 days or more is an indication that embryonic death has occurred. In the breeding pasture, bull activity may appear to increase when it would normally be dropping off.

A meta-analysis (Reese et al., 2020) of early embryonic loss identified impacts of parity, subspecies, and breeding method. First-calf heifers experience more embryonic loss than yearling heifers, with loss in mature cows falling in between the two younger groups. *Bos indicus*-influenced cattle had more embryonic loss than *Bos taurus* females and may reflect the more challenging environments where *Bos indicus* breeds are most common. In comparison to artificial insemination (AI) after observed estrus or fixed-time AI, embryo transfer resulted in the most embryonic loss. The least amount of early embryonic loss was noted with AI after observed estrus. Individual sires may influence pregnancy wastage and is an area of ongoing research.

Causes of embryonic loss can include genetics, disease, management, and toxins. At this time, there is not much that can be done to prevent losses in beef cows from genetic causes; however, considerable research is underway. The large amount of data and intense adoption of genomic testing has been an advantage the dairy industry has in discovery and application of this information. The dairy industry has identified several haplotypes that cause embryonic loss and can now avoid mating carriers of those mutations. This work is ongoing in the beef industry and should provide the same types of benefits in the future.

Common diseases that can cause early embryonic death include bovine viral diarrhea virus (BVDV), leptospirosis, campylobacter (vibriosis), and trichomoniasis. Their potential effects are not limited to early pregnancy loss and will be covered in more detail in the abortion section.

Several stressors can contribute to embryonic loss. Stress increases cortisol, which interferes with reproductive hormone production. Cortisol increases during transportation. After several hours of trucking, AI pregnancy was lowered if the travel occurred 8 to 12 days or 29 to 33 days after AI but not 1 to 4 days after AI. Response to stress is influenced by genetics and animal handling. A more excitable temperament (more stressed during handling) has been associated with delayed puberty and lower pregnancy rates. The embryo seems most sensitive to these stressors from day five after mating (when the embryo reaches the uterus) through recognition of pregnancy around day 17 to day 18, but the embryo is still at risk until placental attachment is complete around day 45.

Short-term nutritional stress causes embryonic loss. This has been shown in studies comparing low- and high-stocking rates immediately before and after AI as well as with apparent reduced intake and gain associated with a transition from a drylot setting to grazing. This issue could arise early in a grazing season when grass growth is much slower than anticipated due to weather conditions (dry, cool, or wet) resulting in reduced forage availability and nutrient intake compared to the prior diet. Feed intake is reduced in temperamental cattle and the decreased nutrient availability can further disrupt reproduction.

Fescue toxicosis is caused by an endophyte that produces the compound ergovaline, which has negative effects on both male and female reproduction and production. In cattle, negative effects on reproduction include the periods of pre-conception through early embryonic development. There are genetic differences in susceptibility, and acclimatization to the endophyte helps diminish the magnitude of problems.

Heat stress has been extensively studied in the dairy industry and may be a factor at times in beef operations. Over time, breeding seasons have generally been established to avoid heat stress; however, unusually hot weather can occur before animals have acclimated to warmer temperatures, particularly if calving date has been shifted closer to grass green up. Heat stress can influence oocyte quality and subsequent embryo development and viability.

The other type of management-related embryonic loss could be the result of miscommunication about which group of animals to work or what they are to be given. A prostaglandin product (i.e., Lutalyse, or Estrumate) will terminate pregnancy if given between five and 150 days after mating.

Abortion

At 60 days of gestation, the fetus is the size of a mouse and rat-sized at 90 days. While the fetus may be expelled at this stage, observing the fetus after abortion is unlikely. There may be evidence of fetal membranes being expelled if observations are timely and close. When abortion occurs, the female will return to estrus within a few days to weeks.

There are many possible causes of abortion, and diagnosis can be challenging. Abortion can be caused by many species of bacteria, several viral species, protozoa, moldy feedstuffs, nutritional deficiencies, and inappropriate vaccine use.

With the exception of several Leptospira species and *Campylobacter fetus*, most bacteria-associated abortions are sporadic, with abortion epidemics rarely occurring. Most of the sporadic abortion-causing bacteria gain entrance into the dam through avenues such as wounds, inhalation, and ingestion. Leptospira species cause both infertility and late-term abortions. These organisms are carried by several animal species including some wildlife. Infected cattle can become chronic asymptomatic carriers and expose herd mates to the organism. Leptospira are commonly shed in urine; therefore, urine-contaminated feed and water are the most common sources of infection. Campylobacter (the old name of this bacteria was Vibrio, and most vaccines list vibrio and not campylobacter on the label) is associated with infertility and early fetal loss, but can, on occasion, cause late-term abortions. This is a venereal disease and can only be spread through natural service or in rare cases contaminated semen or AI equipment.

The viruses associated with abortion include infectious bovine herpesvirus-1 virus (IBR) and bovine viral diarrhea virus (BVDV). In most years, infectious bovine herpesvirus-1 is the most commonly found virus in bovine abortions at the Kansas State Veterinary Diagnostic Laboratory. Infectious bovine herpesvirus-1 virus can be spread by sexual contact and by nose-to-nose contact with an infected animal. Abortions caused by infectious bovine herpesvirus-1 typically occur during the last trimester of gestation. This virus is maintained in many herds through asymptomatic carrier animals. Bovine viral diarrhea virus can cause reproductive issues starting with fertilization all the way to late-term abortions. This virus can be shed by either persistently infected (PI) or acutely infected animals through many avenues including aerosols, saliva, tears, urine, and fetal fluids. Some wildlife species have also been known to carry this virus.

Tritrichomonas foetus (Trich) and *Neospora caninum* are two protozoal species associated with bovine abortions. *Tritrichomonas* can only be spread by sexual contact. Bulls are the primary carriers of this disease, but on rare occasions, cows also can be carriers. Fetal loss due to trichomonas usually occurs within the first 60 days of gestation. Neospora commonly causes abortion between three and six months of gestation. This organism is carried by dogs and coyotes. Canines become infected by feeding on Neospora-infected aborted fetuses or placentas; they subsequently pass the organism in their feces. Fecal-contaminated water and feed are the sources of infection for bovines. Infected bovines can be asymptomatic, but infected for life, and can pass the organism to their offspring before birth.

Several mold species are known to cause bovine abortions. Most mold abortions occur during the gestational period of four months to term. Mold can gain access to the pregnant heifer or cow either through ingestion or inhalation (inhalation thought to be the most common route). Molds found in hay, protein cubes, and silage are the most common sources of infection. Both sporadic and epidemic abortion patterns are common.

Nutritionally associated abortions have been linked to vitamin A, vitamin E, selenium deficiencies, and nitrate toxicities. Many times, in these nutritionally associated abortions, both late-term abortions and weak calves are simultaneously observed in the same herd. Other nutritional issues, including protein and energy deficiencies, can cause abortions, but typically there are clinical signs observed in the pregnant dams (such as alert downer cow, poor body condition, poor colostrum production) at the same time. Waldner, 2014, found the odds of abortion occurring were 1.6 times higher in cows with a body condition score less than five at the time of pregnancy testing compared to a score of five or more. Replacement heifers and cows older than 10.5 years of age were more likely to abort than other age groups. Abortion incidence was higher in cows with twin pregnancies.

A common cause of abortion occurs in herds when pregnant heifers or cows are vaccinated with a modified live viral vaccine that includes the infectious bovine herpesvirus (IBR) virus. Several modified live vaccines containing IBR are labeled as safe when administered to pregnant animals ***if*** the pregnant animal has been vaccinated in the previous 12 months with the ***same*** vaccine. If they have not been previously vaccinated within this time, the risk of abortion is high. These human-induced abortions can occur during any gestation period and typically occur within seven to 10 days after the vaccine is administered.

Diagnosis

Pinpointing the cause of an abortion can be difficult, and doing so incurs costs. Because some level of abortion is considered normal (fewer than 2% between a weaning time pregnancy diagnosis and calving), the question becomes, when do you become concerned? Any time evidence of abortion is found, be it speculative or definitive (fetus found), at minimum record the date and the cow ID if known.

Diagnostic lab data reflect a definitive diagnosis 30% to 50% of the time when only one fetus is submitted. If more than one fetus or section of placenta is submitted, the odds of diagnosis increase one-and-a-half times. When several sections of the placenta are included, the likelihood of diagnosis increases three times. Sections sampled should include cotyledons and the tissue between cotyledons. When an aborted fetus is found, attempt to collect the fetus and placenta so, if further abortions occur, you can glean information from one more calf. Ideally the entire fetus and placenta would be kept refrigerated, not frozen. Retaining sections of placenta is better than no placenta. Consult with your veterinarian on what to collect if retaining the entire fetus is not practical.

A cow that was diagnosed as pregnant but fails to calve is always a disappointment. If pregnancy diagnosis was performed relatively early (30 to 60 days), expect more embryonic loss compared to females diagnosed at a more typical weaning age (see Figure 1). This is normal attrition and not a result of the pregnancy exam itself. Pregnancy diagnosis, regardless of method, requires skill, and skill sets vary and humans do make mistakes. When troubleshooting poor pregnancy results or an apparently high abortion rate, the possibility of human error should be included. The ability to conduct a pregnancy test from a blood sample can be helpful but it cannot differentiate between a pregnant animal and embryonic loss that occurred before the sample was collected. The frequency of a false positive diagnosis with a blood test for pregnancy-associated glycoproteins is about 5% and could inflate actual fetal wastage. Be sure to follow directions for the specific test used so that pregnancy-associated glycoproteins from a previous pregnancy are no longer in the blood stream.

If there is good reason to have confidence in the original pregnancy diagnosis, it may not be possible to eliminate all causes for the fetal loss, but major infectious causes can be ruled out. Work with your veterinarian to collect blood samples from three to five cows that were called pregnant and failed to calve and a minimum of three samples from pregnant cows or ones that calved. The titers to various pathogens can be used to determine if animals were exposed to active disease.

Recommendations

The sooner any excessive reproductive loss, regardless of the timing, can be noted, the more management choices the producer has to minimize the financial impact. Observe cow and bull behavior throughout the breeding season. Take a few moments to record the date and identification of cows and bulls when mating is observed. This information is valuable if an unusual amount of loss occurs. If neighboring cattle get mixed with the herd, record the date.

Consider timing pregnancy diagnosis so that pregnancies can be staged more accurately, usually fewer than 100 days after the start of the breeding season. Bulls could remain with cows and potential open or late breeds rechecked. Late-bred cows could still be marketed as bred at a higher value than opens.

A good biosecurity plan minimizes exposure to disease. Make sure heifers or other herd additions have completed a vaccination schedule appropriate for the disease pressure in your area. This is a good place to invest in testing for persistent infections of bovine viral diarrhea (BVD). Most vaccination protocols should include infectious bovine rhinotracheitis (IBR), both types of bovine viral diarrhea (BVDI and BVDII), leptospirosis, and campylobacter. Isolate purchased animals for 30 to 45 days before introducing to the remainder of the herd. Review health and biosecurity plans from herd sire providers. Leverage the knowledge of your local veterinarian who has insight on health in multiple herds and the success of various vaccine manufacturers in protecting against the strains in your area.

Sound year-round nutrition is needed to minimize pregnancy wastage. Test feedstuffs for nutrient quality, use the forage test information to identify deficiencies and appropriate supplementation. Vaccines may be wasted if the animal is deficient in protein/energy/trace minerals or vitamins. Drought-induced changes in feedstuffs may require different nutrient supplementation strategies. Weather and other stressors will come, and the cow's ability to deal with stress is related to her general health and nutrient status.

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