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Understanding and Minimizing Pregnancy Loss in Cattle

Loss of a pregnancy (Figure 1) among cattle can occur from a variety of causes, ranging from environmental factors, like weather, to factors that can be managed proactively, like nutrition and timing of transport. Any management or environmental factor that negatively affects the ability of a female to calve early in the calving season has significant impacts on reproductive efficiency and overall production within a herd. Minimizing pregnancy loss within a herd is important and can be accomplished with good management. This can include limiting the stress placed on pregnant animals and taking preventative measures against diseases and other causes of pregnancy loss.

The majority of pregnancy loss occurs within the first 30 days of gestation (Figure 2), with much of this loss being early embryonic loss. Very early losses can be difficult to identify, as losses prior to maternal recognition of pregnancy do not affect the length of an estrous cycle. This publication details some common causes of pregnancy loss and provides management practices that can help minimize the incidence of pregnancy loss.

Figure 1. A bovine pregnancy at approximately 2.5 months gestation. Photo courtesy Dr. Maarten Drost, University of Florida, made available through the American Society of Animal Science.

Genetics

Genetic factors resulting in embryonic mortality appear to be a major cause of pregnancy loss in cattle, particularly in purebred or straightbred cattle. Although several genetic defects are already named and well-described in the scientific literature, it is thought that a much larger number of recessive lethal alleles may exist within domestic cattle populations. When both the sire and dam carry the recessive lethal allele, approximately one quarter of the offspring would be anticipated to be a homozygous recessive at that locus and therefore undergo early embryonic death. Moreover, it is thought that animals typically carry multiple recessive lethal alleles, and it is simply a question of whether the sire and dam happen to have a recessive lethal allele at the same locus.

Alleles that result in lethality can exist in relatively high frequencies within a population simply due to genetic drift following a population bottleneck, such as may occur when very popular sires are used extensively within a breed. Although it remains unknown exactly how many lethal alleles exist in domestic cattle populations, recent research efforts both in dairy (Fritz et al., 2013. PLoS One 8:e65550) and beef cattle (Hoff et al., 2017; BMC Genomics 18:799) have demonstrated the existence of lethal recessives at moderately high frequencies. Since most of the resulting losses are thought to occur very early in embryonic development, these genetic causes of pregnancy loss will be perceived as generally reduced fertility (e.g., reduced pregnancy rate per AI service), even though fertilization is in fact occurring.

Transportation stress

Hauling cattle shortly after a breeding event can result in increased incidence of early embryonic loss. Transportation of cattle is inherently a stressful event, increasing cortisol levels in the body to potentially

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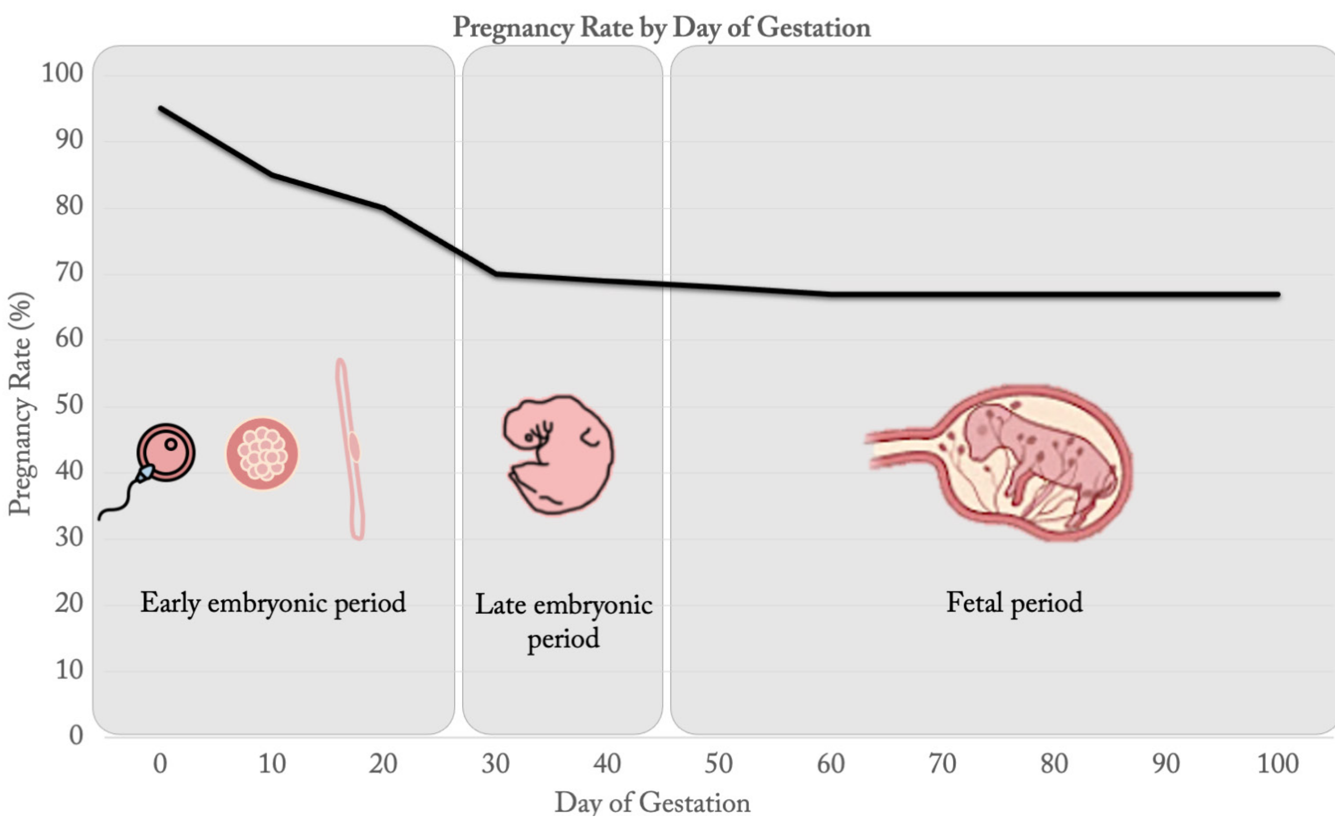
detrimental levels. Elevated cortisol can impact timing of ovulation, if transportation takes place the day of or the day following breeding. Because of the stress associated with loading, hauling, handling, and arriving at a new environment, transporting females around the time of artificial insemination is discouraged. The associated increase in cortisol levels could delay ovulation of the oocyte and have detrimental effects on both fertilization rate and embryo quality. If possible, avoid moving cattle during this time.

Transporting cattle between day 5 and day 60 of gestation has been shown to result in pregnancy losses as well. The embryo moves from the oviduct to the uterus around day 5 of gestation and continues developing. At this point in time, the embryo is particularly susceptible to environmental changes. Several developmental changes occur in the following weeks, including elongation of the embryo and release of the conceptus signaling hormone, interferon tau. This is the signal associated with maternal recognition of pregnancy, which prevents luteolysis and the initiation of a new estrous cycle. Throughout this time, the uterus is susceptible to stress-induced hormonal changes that can affect successful pregnancy recognition and eventual implantation of the embryo. Substantial losses can occur during this time. For example, one research study conducted by Colorado State University found that hauling cattle 5-42 days following insemination resulted in a 10% reduction in AI conception rates when compared to animals not transported (Merrill et al., 2007. J Anim Sci 85:1547–1554).

If transportation of recently inseminated females is absolutely necessary, doing so between day 2 and day 5 following insemination is recommended. This method results in transportation occurring while the embryo is still within the oviduct and less susceptible to changes in the uterine environment. If transportation is not carried out within that 4-day period, research suggests producers should wait to haul cattle until they reach at least day 42 of pregnancy. This avoids the period of early development and attachment of the embryo, as well as the establishment of the placenta. The attachment of the embryo and establishment of the placenta occurs between days 22-42 of pregnancy. Once that pregnancy is well established, the developing fetus is less susceptible to environmental changes. Transportation-associated losses can still occur after this point, however, so producers are encouraged to avoid transportation of bred females entirely if possible, or at least delay transportation until mid-gestation.

Like any cattle handling event, transportation can be stressful. If you plan to haul cattle during pregnancy, avoid overcrowding and utilize low-stress stockmanship. With the majority of pregnancy loss occurring during



Figures 2. Illustration of reduction in pregnancy rate by day of gestation. Note that most pregnancy loss in cattle occurs in the early embryonic period.

the early embryonic period, avoiding stressful situations throughout this early development can help decrease the incidence of embryonic loss.

Heat stress

Heat stress can also increase incidence of embryonic loss, especially within the first couple weeks after breeding. An increase in body temperature may result in an increase in the temperature within the uterus, and stress can also decrease blood flow to the uterus. Cattle start to endure severe heat stress at a temperature-humidity index of >84. This can occur at temperature ranges that are as low as 84 degrees Fahrenheit, depending on the relative humidity. Heat stress leads to increased body temperatures, respiration rates, sweating, and standing. Pastured cattle will typically be less susceptible to heat stress when compared to those in lots. Adequate shade, water, and air movement helps regulate the females' body temperature.

Water intake will increase with heat stress, as intake of water below body temperature is the fastest way to cool down an animal's core body temperature. In a pasture grazing system in heat stress prone climates, water systems should be designed in such a way as to ensure intake of water is not limited by the distance required for travel to water. Minimizing travel by supplying water within 650-1,000 feet of all portions of a paddock can help reduce traffic at tanks, likely decreasing heat stress. While this may sound expensive, consider also the return-on-investment potential from the improved forage utilization in the grazing system that can be facilitated by greater water point frequency.

Pressure from flies and other parasites can also exacerbate the effects of heat stress. Biting flies may cause cattle to bunch up in groups, decreasing their potential to cool. Horn flies create the biggest issues for pastured cattle and should be controlled through management and/or insecticide interventions prior to the start of heat stress.

Heat stress can be reduced through management practices like ensuring adequate access to shade and water. The use of fans and/or ventilation can be effective when cattle are housed within a building. Cattle in lots may require greater access to water, as dominant cattle can stand at tanks for hours, preventing other cattle from drinking an adequate amount. Recommendations vary, but for cow-calf operations, water tanks that allow about 15-25% of the group to drink at one time are ideal.

Handling of cattle elevates their body temperature. Cattle should not be processed in extreme heat and should be processed only in the cool early morning hours when it is hot. If avoidable, don't work cattle in the evenings during hot weather, as cows have not yet recovered and dissipated the day's heat load even though atmospheric temperatures may have decreased. With this in mind, it may be effective to avoid typically hot months when considering a designated breeding season. This can serve as another management practice to minimize incidence of pregnancy loss associated with heat stress.

Expression of estrus

Fixed-time AI protocols are becoming more popular in the beef industry in part due to the reduced labor associated with carrying out an AI program. With a fixed-time AI protocol, maximizing estrus expression is variable among females prior to the time of fixed-time AI. Unfortunately, cows that fail to express estrus prior to fixed-time AI appear to be at greater risk of early embryonic loss. Expression of estrus is associated with hormonal events that set the uterus up to receive pregnancy. Although ovulation can be induced using gonadotropin-releasing hormone (GnRH) among females that fail to express estrus and fertilization of the oocyte may occur, the lack of the other hormonal changes that would have been associated with estrus results in greater incidence of early embryonic loss among this subset of females. This is likely one major contributor to the reduction in pregnancy rates observed among females that fail to express estrus prior to fixed-time AI. A recent meta-analysis including data from over 10,000 cows and heifers, indicated that females that express estrus prior to fixed-time AI, on average, have a 27% greater pregnancy rate to fixed-time AI compared to females that did not express estrus (Richardson et al., 2016. Anim Reprod Sci 166:133–140).

Fertilization rates are thought to be high in cattle, with most early fertility failures being attributed to embryonic death. Uterine environment and receptivity is a major driver in pregnancy establishment and maintenance. By controlling expression of estrus through synchronization protocols, we manipulate the hormones that control the uterine environment, specifically, preovulatory estradiol and postovulatory progesterone levels. Pre-ovulatory estradiol drives progesterone receptor population in the uterus, and recognition of progesterone by the uterus is essential for the establishment and maintenance of pregnancy. Ultimately, therefore, choosing an estrus synchronization protocol that maximizes the proportion of cows and/or heifers that express estrus should be a priority if seeking to maximize pregnancy rates to AI and minimize early embryonic loss.

Nutrition

Managing nutrition and cattle body condition scores can decrease the amount of time it takes cows to return to estrus after calving. Inadequate body condition or negative energy balance (failure to meet the female's nutritional requirements) can also contribute to pregnancy loss. Cattle that are decreasing in body condition following breeding have a greater likelihood of early pregnancy loss as a result of maternal environmental factors. Nutrient restriction following AI can even have negative effects on embryo quality and early embryonic development.

Take a proactive approach to managing body condition. Evaluate body condition off females 60 days prior to calving and adjust diet or provide supplementation accordingly. Manage for a body condition score of 5 to 6 in multiparous cows and a body condition score of 6 in first-calf heifers at calving. It is critical that changes in body condition be achieved prior to calving rather than attempted after. As a result of lactation, energy requirements are the greatest following calving, so it can be very difficult and expensive to wait to add body condition to cows during this time.

A reproductive challenge that often impacts cow-calf profitability is breed back on first-calf heifers (two-year-old cows with their first calf at side). This challenge exists because first-calf heifers can easily become nutritionally limited during the third trimester of pregnancy and into lactation. These females have not yet reached their mature weight and are being asked to maintain their body condition, continue to grow, lactate, and rebreed. Their energy requirements are greater than that of mature cows, and the breeding season occurs when the cow requires the highest quality diet during lactation. Because of the young cows' high requirements, this age class typically represents the largest risk of reproductive failure in an operation. Weigh the economics and logistics of maintaining young cows as a separate management group with a nutritional management system designed specifically for the unique needs of this age class.

Abrupt changes in diet can also have a negative impact on pregnancy rates by affecting embryonic development and the uterine environment. Any substantial shift in diet can cause changes in microbial composition of the rumen. Too quick of an adjustment can cause issues that affect pregnancy rates. For example, a relatively common practice is to develop heifers in a dry-lot here in the Midwest, performing estrus synchronization and AI before turning clean-up bulls and heifers out to pasture. A potential issue with this practice is the abrupt shift in diet and activity levels of those heifers following AI. A study conducted by South Dakota State University found that heifers went into a negative energy balance when transitioned from a dry-lot to a pasture. This was associated with a dramatic increase in activity as heifers walked the fences of the pasture and reinitiated grazing behavior. The heifers were losing body weight despite grazing high-quality forage and as a result had reduced pregnancy rates to AI when compared to heifers that were managed on pasture throughout the process (Perry et al., 2013. Prof Anim Sci 29:595–600). Given these data, several alternative strategies should be considered. For example, it may be beneficial to acclimate heifers to pasture prior to breeding. Alternatively, an operation could continue to feed heifers in a lot until day 42 of gestation. Hybrid strategies could involve turning heifers out to a smaller paddock to avoid initial excessive activity and/or supplementing heifers on pasture with a ration with which they are familiar. Ultimately, it is beneficial to heifer pregnancy rates for females to be gaining rather than losing weight following breeding. Transitioning cows from stored forage to lush, washy pasture shortly after breeding can have a similar negative effect on body weight and early conception rates in spring breeding programs.

Toxins

Another nutritional issue that can result in pregnancy loss is the presence of a toxin in the diet. Common concerns are mycotoxins, nitrates, or specific toxins associated with certain plant species. Endophyte-infected tall fescue is particularly common in Missouri, and decreased conception rates are observed among cattle grazing tall fescue during the hot summer months. Cattle suffering from fescue toxicosis will have decreased feed consumption and weight gain, as well as increased body temperatures and vasoconstriction-associated heat stress. This issue can be mitigated through good forage and grazing management. This may include managing for greater diversity of forage species composition in pastures, such as incorporating legumes and other grass species (e.g., native warm-season grasses) in the farm's grazing system. The toxic portions of endophyte-infected tall fescue include the seed head and base of the plant. Avoid overgrazing tall fescue and ensure that cattle are not asked to consume these toxic portions of the plant. This can be managed either with good grazing management or through clipping pastures when fescue enters the reproductive stage, as clipping fescue resets the plant's life cycle toward vegetative growth.

To avoid other mycotoxins, test forages. Mycotoxins are more likely to become an issue during wet conditions or when feed has been exposed to moisture. Mycotoxins can result in abortions, decreased fertility, and an overall decrease in production within the herd. Monitor feedstuff, especially when conditions are ideal for fungal growth (i.e. warm, wet conditions). Although often misunderstood as resulting from the endophyte in fescue specifically, mouse dropping-like ergot can occur in the seed head of a large number of cool season grass species in Missouri and is extremely toxic. Removing cattle from fields with heavy ergot loads is generally recommended. Stored feedstuffs and harvested forages can also be a source of mycotoxins either because of the presence of these toxins in the harvested forage or because of storage conditions. Store most dry feeds in a low moisture environment that allows for cover and protection from the weather to avoid excessive mold growth, and consider testing suspect forages that may have developed mycotoxin problems prior to harvest.

Nitrates can also cause abortions as well as an overall decrease in animal performance, with severe cases resulting in animal death. Overconsumption of plants containing nitrates can result in nitrite accumulation in the blood, decreasing oxygenated blood. Nitrates will occur in certain forages following stress events like a frost or drought. A good management practice is to keep animals off the plant and avoid harvesting it for two weeks following a stress event. Note that this resting of the forage base will need to be repeated following each time the forage is stressed if the forage is actively growing. Avoid overstocking on nitrate containing forages as this pushes cattle to graze the nitrate containing portions of the plant, increasing nitrate consumption. Supplying cattle with another forage option, like grass hay, will decrease overall nitrate intake. Another mitigation strategy is feeding grain along with a plant that may contain nitrates. Grain, like corn, will provide energy for the rumen microbes to convert nitrate to bacterial protein, reducing the risk of nitrite accumulation. Test harvested forages for nitrates and do not feed a nitrate containing forage alone. Work carefully with an Extension specialist or nutritionist when seeking to utilize feeds containing nitrates. It is also good practice to test water for nitrates as a small amount in both the water and forage can add up.

Health

Animal health is an important component of reproductive efficiency and overall performance within a herd. The best way to minimize pregnancy loss as a result of disease is through preventative herd health practices. Proactive measures, like pre-breeding booster vaccinations are especially effective at reducing incidence of fertility issues associated with disease. Good biosecurity practices can help minimize disease-related abortions by limiting exposure to potentially infectious agents. Additions to the herd should be tested for venereal and other high-risk transmissible diseases prior to exposure to the herd. Quarantining new additions for 21-30 days is also a good herd health practice to follow. This allows producers to identify any potential conditions the animal may have before exposing them to the rest of the herd.

Another consideration is control of internal and external parasites, which can cause general stress and decreased production. External parasites such as biting flies and ticks can also transmit diseases between animals within the herd. In moderate cases of parasitism, some reduced level of reproductive performance may be noted. In more extreme cases, high parasite loads can result in losses of confirmed pregnancies. Even subclinical parasite effects can negatively impact overall production, so monitoring external and internal parasite load will help to identify and prevent parasite-associated reproductive losses. Parasite control is most effective when multiple management methods are utilized.

When it comes to herd health, each operation will differ in the issues they face. It is important to form a good relationship with a veterinarian and discuss herd-specific needs with him or her. A veterinarian can help to design a vaccination and treatment protocol that fits the risk profile and management goals of the operation. For more information on disease and parasite control and prevention, visit MU Extension publication g2044, Herd Health Programs and Reproductive Efficiency of Beef Cattle (https://extension.missouri.edu/g2044).

Summary

Although the potential for pregnancy losses can be worrisome, proactive management systems can help to minimize the occurrence of these costly losses. Most losses occur early in pregnancy and are unlikely to be observed as anything other than reductions in pregnancy rate or a calving distribution that is not as front-loaded as desired. Work toward continual improvement of the overall management system by reducing the opportunities for stress, suboptimal nutrition, or other challenges that can result in pregnancy loss.

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