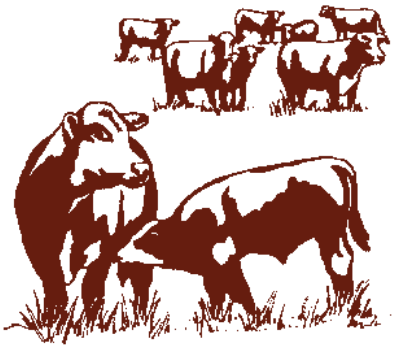
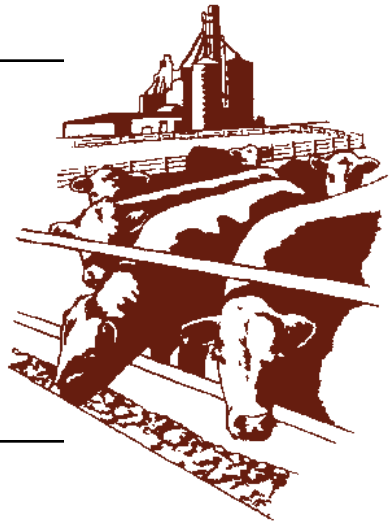


Beef Cattle Handbook



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Embryonic Mortality in Cattle

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Introduction

Embryo mortality is a difficult problem for farmers to deal with. The establishment and maintenance of pregnancy is a highly complicated process involving the embryo, uterus and cow. There is no single factor that can be manipulated that will consistently improve embryonic survivability. But, by managing genetics, nutrition, parity, stress, and animal health the incidence of embryonic loss can be decreased considerably.

Fertilization rates in cattle are generally between 90 - 100 percent, with only 70 percent of all fertilizations resulting in a live birth. Therefore, 30 percent of fertilizations are lost to some form of embryo demise. In essence, this results in approximately a $1.4 billion loss to cattle producers, nation-wide.

This review will address some of the factors directly or indirectly affecting the ability of an embryo to survive within the confines of the maternal environment.

Factors Affecting Embryonic Death

Genotypic Factors

Most genotypic abnormalities will cause the death of the embryo within the first two weeks of pregnancy (King, 1990). Sometimes, a lethal gene will be expressed which causes the death of the embryo within the first five days of pregnancy. Another genotypic factor contributing to embryonic death is an abnormal chromosome number that results in abnormal growth of the embryo, and usually death within the first trimester of gestation (King, 1990). A high percentage of genetic related embryonic deaths often results from genes that are important for the development of the embryo or young fetus and may not be expressed appropriately.

Nutritional Effects

Effects of Toxins. The effects of toxic plants vary considerably with the environment. Some toxins may be more toxic during certain seasons of the year, while others may have different effects according to the stage of embryo development. Additionally, plant toxins can effect spermatogenesis in bulls, oogenesis in cows, and even a nursing calf can be affected through milk consumption. Toxic plants do not only cause embryonic death but also have been known to cause abortions, skeletal abnormalities, and retarded fetal growth (James et al., 1991).

Identifying toxic plants is essential to cattle producers in an effort to minimize the effects of toxins on the calf crop. The table below lists common toxic plants, along with the effects to the fetus, for which those plants are responsible.

Toxic Plant	Effect
False hellebore	Fetal death, facial defects, skeletal defects
Lupine	Skeletal defects, cleft palate
Poison Hemlock	Skeletal defects
Locoweed	Abortion, embryonic death, delayed placentation, skeletal defects
Tree tobacco	Skeletal defects, cleft palate
Ponderosa pine	Abortion, premature birth
Broom snakeweed	Abortion
Little leaf horsebrush	Abortion

Effects of Energy and Protein. There is little experimental data correlating the effect of nutrition on embryonic mortality and most of the studies include failure of fertilization along with embryonic mortality. However, we know that energy and protein levels play a role in maintaining pregnancy. It is essential for cows to be in adequate condition in order to minimize embryonic loss (Wiltbank et al., 1962). Producers can manage condition by scoring the cows body condition several months before breeding, and adjusting diets according to specific needs. Cows will have less embryonic mortality if they are gaining condition, while those losing condition will tend to have higher embryonic loss (Wiltbank et al., 1962). It is usually easy to determine energy levels in drylot situations. Range conditions can pose a problem when estimating energy intake, and is where body condition scoring has the most benefits.

It has been documented that an excess of protein will increase embryo mortality (Blanchard et al., 1993; Elrod et al., 1993). Excess levels of dietary protein could possibly alter hormone secretion, such as progesterone, in the uterus or could increase blood urea concentrations. These changes could be toxic to the developing embryo. Excess dietary protein is not a problem in range cattle (except in extreme cases on wheat pasture or alfalfa), but could pose a problem for bunk fed cattle forced to perform at extremely high levels. Dairy cattle fed high protein diets are usually exposed to this problem (Kaim et al. 1984).

Asynchrony

After fertilization, embryos cleave at different rates, sometimes causing the maturity of the embryo to differ from that of the uterus. The uterine environment may be toxic to these embryos that are out of phase, resulting in the death of the embryo. Maternal recognition occurs around days 15 - 17 of pregnancy. The embryo secretes bovine trophoblast protein-1 (bTP-1) which alters the production of prostaglandins and prevents luteolysis from occurring. If the embryo does not signal its presence adequately to the mother, the mother will continue to cycle as if open (Geisert et al., 1988).

The Role of Progesterone

Progesterone is essential for the maintenance of pregnancy. If a cow does not produce sufficient progesterone levels, the pregnancy will be lost. There are two major reasons for a lack of progesterone. The first category includes corpora lutea (CL) that have a short lifespan. Thus, luteolysis occurs before the embryo has time to signal its presence through secreting bTP-1. The second category includes those CLs that have a normal lifespan but secrete low levels of progesterone, which does not suppress the luteolytic affects of the prostaglandins. Experiments have been done to supplement cows with progesterone, which extends the life of short lived CLs or increases the progesterone production. This allows for maternal recognition to take place and less chance of luteolysis occuring (Robinson et al., 1989). There is currently no practical method to determine whether a cow requires progesterone supplementation, however hopefully with further research methods will develop in such a way that producers can reduce embryonic mortality through the use of progesterone supplementation.

Infectious Agents

Today, producers are more aware of infectious agents responsible for abortion or embryonic death. With the development of cost effective vaccinations and other methods to control infections and disease, infectious agents are becoming less of a factor for embryonic survivability. It is essential to understand the importance of maintaining these agents to a minimum by using vaccinations and medication, as they could return to the epidemic proportions they once were.

Bacterial Agents. Corynebacterium pyogenes is the most common bacteria found in the uteri of cattle. This bacterium is the largest cause of endometritis in cows. Research also shows that *C. pyogenes* is responsible for aborted embryos, fetuses, placentae, and vaginal discharge (Griffin et al., 1974a,b). *Campylobacter fetus* (commonly known as "vibrio") is easily transmitted from cow to bull or vice versa, and cows can remain infected for up to six months. Vibrio is responsible for infertility and causes early embryonic mortality in cows (Adler, 1959). *Brucella abortus* ("bangs") has more of an effect during mid-to-late gestation and causes abortion. All heifers should be vaccinated at weaning to avoid the incidence of this bacterium in causing abortion (Stringfellow et al., 1982).

Viral Agents. Bovine herpesvirus-1 (BHV-1) is a group of viruses that includes IBRV and IPV. This group is responsible for more abortions than any other infectious agent. BHV-1 also causes early embryonic death, cystic CLs and some pathological changes to the uterus (Engels et al., 1981). Bovine viral diarrhea (BVD) has been shown to cause early embryonic loss, but is not a major cause of embryonic mortality in cattle (Whitmore et al., 1981).

The Effects of Palpation

It is generally understood that rectal palpation does not effect the survivability of embryos. There seems to be a 5 percent embryonic loss, from day 28 - 60, regardless of whether cows are palpated or not. Through palpation, producers can identify open cows or problem breeders and can cull cows that do not meet herd requirements.

Other possible factors

Age. It has been documented that heifers have a higher conception rate than cows. Heifers do not have the added stress of nursing a calf, or the possibility of infection to the uterus from a previous birth, through a difficult birth or retained placenta. Older cows nearing the end of their reproductive life will also have an increase in embryonic mortality (Erickson et al., 1976).

Breed. Little difference in embryonic mortality across breeds has been shown (Casida, 1950). If cattle

are maintained in optimum condition, the breed does not alter the incidence of embryonic death. Studies have shown that certain bloodlines may be more apt to have decreased fertility or lower secretion of progesterone. However, this occurs within each breed. Cattle that are linebred or inbred have been noted to have an increase in embryo mortality.

Affect of the Male. There are two areas that the male can contribute to increasing embryonic death. The first area is genetic, where the male transmits possible lethal genes, abnormal chromosome numbers or some genetic mutation. This area probably cannot be detected from a management standpoint, while the second area can be controlled through vaccination. Bulls that are infected with some infectious agent like vibrio can spread this infection throughout the herd. Therefore, careful health management of the male is essential to controlling embryonic mortality.

Conclusions

Managing genetics, herd health, nutrition and parity are important in keeping embryonic loss to a minimum. Numerous factors have an affect on the survivability of the embryo. Nearly 65 percent of all embryonic loss occurs between days 6 - 18 of pregnancy. There is no clear-cut recommendation or hormonal preparation that will reduce embryo loss. Cattle should be kept on a high plane of nutrition with uterine and ovarian infections kept to a minimum. As long as a solid reproductive program is maintained perhaps, for now, cattle breeders will have to accept as normal the current high death rate of embryos. Further research is needed to understand the mechanisms responsible for embryonic mortality before economical methods can be used by the producer to increase embryo survival.

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