REPRO TRACKS

by Cliff Lamb, Texas A&M University

Back to Basics

How is a calf conceived and carried to term?

The goal of a productive beef cattle producer is to have every cow produce a calf every year. However, a 60-65% first-service conception rate and more than 90% calf crop is something we can realistically strive for in a given calving window.

This results in 75-90% of cows in a herd weaning a calf that provides value back to the herd. As a single-offspring-bearing species, these percentages are exceptional considering what has to occur for a cow to express estrus and ovulate, have a successful fertilization, ensure the embryo and the fetus grows appropriately, and a live calf is delivered. There are no other domestic or wild single-offspring-bearing species that are this fertile and successful at delivering a live offspring annually.

Fertility in a herd can often be improved through sustained commitment to management decisions, such as ensuring cows are capable of becoming pregnant. Management includes a solid herd health program where livestock are vaccinated annually against pathogens that may have an effect on fertility, a nutrition plan that focuses on the necessary nutritional requirements of a female, and other strategies that have been known to have a positive effect on the ability of a cow to become pregnant and deliver a live calf. Producers willing to focus on these items will be ensured of greater success.

Steps to success

For a female to have a successful pregnancy, she needs to have all of the functional parts of a reproductive tract, such as the vulva, vagina, cervix, uterus, oviducts and ovaries. Some producers utilize a reproductive tract scoring system to determine if these parts are all present and appear to be functional.

For a male to breed cows, the male needs to have testes, scrotum, epididymis, vesicular glands and penis without abnormalities. If these are all normal, then a breeding soundness exam (sometimes referred to as a BSE) will determine whether the bull has the ability to ejaculate and produce sperm capable of establishing a pregnancy. A bull also needs the libido (desire to breed) to actually mate heifers and cows.

If the females and males have the functional anatomy, then several physiological events need to occur for a pregnancy to be established.

The journey of the oocyte (unfertilized egg) to conclude in a term pregnancy involves more than simply moving from the ovary to the middle of the oviduct. Unlike sperm, all the oocytes (eggs) that will ever be produced were made while the female was in the early stages of fetal development while in utero. In other words, the maximum number of oocytes are actually present before the female is born.

At birth, heifers typically have about a million oocytes with the majority located in ovarian “egg nests.” If one assumes a beef cow is capable of producing 10 to 12 calves in her lifetime, clearly the vast majority are not utilized for the purpose of making a calf. Rather, the majority at some point or another degenerate/die as a result of follicle turnover. While there is not a test or assay to determine which oocytes will result in a calf, many more than 10 are capable, since calves are routinely produced from oocytes obtained from superovulation procedures and abattoir-derived ovaries.

When a female comes into estrus, typically only one follicle will ovulate with one oocyte, whereas during the estrous cycle several additional follicles will have grown and degenerated, causing the demise of other viable oocytes. The journey for the oocyte resulting in a pregnancy begins while the female is in utero during gestation, but may not be completed until the animal/oocyte is 8 to 15 years of age.

Compared to the oocyte's journey from the ovulatory follicle to the midsection of the oviduct, the spermatozoon (a single sperm cell) resulting in a pregnancy travels a significant distance, starting in the testes where it takes about 60 days to transform from a spermatogonium to a spermatozoon in the seminiferous tubule. Once the sperm becomes as we know it (i.e., has a head and a tail), it begins its journey out of the testes to the epididymis, where it becomes motile and can fertilize an oocyte.

Sperm are deposited into the vagina of the cow after natural mating, or can be collected for eventual artificial insemination (AI) in the uterine body. Of the billions ejaculated, as few as about 100 spermatozoa reach the site of fertilization. Only after binding to a receptor will the spermatozoon be able to make its way through into the oocyte. This process is referred to as fertilization, a critical step in the formation of a developmentally competent embryo.

Once fertilization occurs, a reaction occurs immediately to block any other sperm from entering. The sperm inside must then be unpackaged to allow its genetic information to ultimately meet up with the oocyte's genetic information. After the two gametes' (oocyte and sperm) genetic information comes together, the resultant zygote undergoes a series of simple cellular divisions.

At the eight to 16 cell stage, the embryo takes over control of its development and if it doesn't, the embryo will not develop further. Ultimately at about Day 8 or 9 of pregnancy, the embryo will hatch and it will elongate throughout the uterus. During this time period, several changes and processes occur that will influence whether the pregnancy is successful to term.

Completion of embryo development and initiation of fetal development occurs around 42 to 45 days of gestation. From there, little loss is expected to occur if disease, malnutrition or other issues are minimized.

At the time of calving, the fetus will actually initiate the process of calving by causing the release of glucocorticoids. This process includes a softening of the cervix and stimulating uterine contractions for expelling the fetus and the placenta after calving.

The majority of loss occurs early during pregnancy and can be caused by several factors. If cows are cycling, express estrus and have been mated correctly, fertilization occurs 95-100% of the time.

Most of the failed pregnancies usually occur in early gestation (i.e., before Day 20). However, the losses that occur after Day 20 likely are those that are of greater cost to a producer, since those females may not have a chance to become pregnant again during the breeding season. Therefore, mitigating negative effects through herd health and nutritional management will enhance embryo survival and increase the percentage of calves successfully delivered at birth. AJ

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