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Managing Genetic Defects in Beef Cattle Herds

Jane Parish – Extension Beef Cattle Specialist, Mississippi State University

Congenital defects are abnormalities present at birth. They are abnormalities of structure or function that can result in calf losses before or after birth. These defects can be caused by genetics, environment, or a combination of these two factors. In some cases, the cause of defects can be unknown.

Genetic defects are due to an abnormal or mutated gene. They may impair animal health or cause a condition of abnormal function or structure. These hereditary defects occur in all breeds of cattle, and some are strongly associated with certain breeds. Over 200 different genetic defects have been identified in cattle. Most of them occur rarely and are of minor concern, but some increase in their frequency to the point that they become a significant economic concern and need to be selected against. Genetic abnormalities may contribute to poor animal performance, structural unsoundness, semi-lethal disease, or lethal disease.

Examples of genetic defects include: achondroplasia (bulldog dwarfism), alopecia, ankylosis, arthrogryposis (palate-pastern syndrome, rigid joints), arthrogryposis multiplex (AM, curly calf syndrome), brachynathia inferior (parrot mouth), cryptorchidism, dermoid (feather eyes), double muscling, fawn calf syndrome, hypotrichosis (hairlessness), hypotrichosis (“rat-tail”), idiopathic epilepsy (IE), neuraxial edema, neuropathic hydrocephalus (NH, “water-head”), oculocutaneous hypopigmentation (white eyes), osteopetrosis (marble bone disease), polydactyly (extra toes), progressive bovine myeloencephaly (weaver calf), prolonged gestation, protoporphyria (photosensitivity), pulmonary hypoplasia with anasarca (PHA), tibial hemimelia (TH), and syndactyly (mule foot).

Identifying Causes of Defects

When an abnormal calf is born, first try to determine if the defect is hereditary. Congenital defects that are not inherited, but are instead environmentally caused, often occur during a short period in a group of cattle managed the same. Malnutrition, toxic factors, infectious disease, or extreme weather may be to blame for these congenital defects.

For example, when a pregnant cow consumes the lupine plant between days 40 to 60 of gestation, her calf may be born with crippled-calf (crooked-calf) disease, a crooked-leg condition. Two-headed calves and calves with extra legs may be the result of fetal development mistakes. Bovine virus diarrhea (BVD) infection during pregnancy can lead to some hydrocephalus. Flexed pasterns can be caused by either a large fetus developing in a small uterus. Each of these conditions may be appear at first to be genetic defects but are actually due to environmental conditions. In the cases of crippled-calf disease and flexed pasterns, the causes could be either environmental or genetic. Once it is determined that a specific environmental cause is responsible for a defect, management changes can be put in place to address these problems and reduce the risk of future incidence.

Some congenital defects are inherited. Most genetic abnormalities are simply inherited and determined by a single pair of recessive genes. In this instance, both parents are “carriers” (heterozygous; one desired and one undesired allele or gene copy) for the defect. Genetic tests for DNA markers can usually help identify these simply inherited defects. Genetic tests for simple traits that are controlled by one gene are able to accurately assess whether an animal is a carrier or will “breed true” (homozygous; two same alleles) for the marker alleles that result in a certain phenotype (physical manifestation of a trait). Breed associations and genetic testing companies can provide testing protocols for genetic defects associated with a certain breed.

If a defect is dominant, no test is needed because the animal would display the defect even if only one dominant allele is present. A small number of congenital defects are caused by genes with incomplete dominance, and a few are caused by two or more sets of genes. If the defect is inherited as incomplete dominance, an animal that has only one undesired allele can usually be identified and testing is not needed.

Genetically caused defects tend to run in families. The sire and dam of a calf will likely have at least one common ancestor. The occurrence of multiple affected calves in a herd often results from a situation where the sire is the same and the dams are related.

Breeders must have good records to determine the cause of defects. These records must include calf parentage, abnormality descriptions and photos or videos when possible, and causes of death. If parentage is not known from records, it can be determined via DNA testing. When cause of death is not obvious, request veterinary assistance to obtain necropsies immediately after any cattle deaths. Necropsies are a valuable tool for investigating possible causes of death and ties to congenital defects. Management groups and movement among paddocks or pastures should be recorded as well. Feed and forage analysis reports, notes of toxic plant presence, and herd health records will also help in diagnosing the cause of any congenital abnormalities.

Managing Genetic Defects

Once carrier and affected animals are identified, producers can make selective breeding and culling decisions to manage a genetic defect within a herd. When a carrier animal is extensively used for breeding purposes, as in the case of sires for artificial insemination purposes, several thousand calves may be sired by the carrier bull before the abnormality expresses itself. Even more matings using the carrier sire may take place before affected calves are associated with the sire and genetic testing confirms the sire as a carrier.

In some cases, a genetic test may not be available at the time of the initial occurrences of the condition in the cattle population. A diagnostic test may then need to be developed based on data submitted from producers observing the defect in their herds.

Therefore, it is prudent to test sires from which semen will be marketed as well as donor dams in embryo transfer programs for known potential genetic defects. Furthermore, producers must remain vigilant about observing calf crops for congenital defects, collecting appropriate records and animal samples for diagnostics, and reporting problems with defect occurrence to breeding animal suppliers and breed associations as appropriate.

Consider the value of a carrier's genetic worth to the breeding program. An animal with one undesirable recessive gene may also have thousands of very desirable genes. With carriers with superior genetics, strategically mate these animals to non-carriers in a terminal crossbreeding program where all calves are marketed for beef production and not for breeding purposes. Alternately, a superior son could be produced for use as a herd sire that does not carry the defect.

In most cases, defect carriers should not be used to produce breeding animals. Therefore, do not keep replacement heifers that are defect carriers. When other cattle with similar or superior genetic merit that do not carry the defect can be utilized, systematically work carrier females out of the herd and replace them with cattle that do not carry the defect. Be sure to send carriers directly to harvest to avoid transferring the defect to another breeding herd.

Purebred breeders and breed associations share responsibility for control of genetic defects in seedstock populations. Seedstock producers have an obligation to the customers they supply with breeding animals as well as their respective breed associations to be honest and notify them when carriers of genetic defects become known. Many breed associations mandate genetic defect reporting among their members. Breed associations may also have rules regarding registration eligibility or required denotations on registration papers for animals carrying or affected with genetic defects.

Make sure that buyers understand the consequences of using offspring from known carriers. Serious ethical and legal problems can be involved in marketing known carrier cattle or progeny of known carriers. Marketing carriers without informing the buyer can not only harm breeder reputation but may also reflect negatively on the entire breed.

Good monitoring and control measures by seedstock operations will help control the incidence of genetic defects in commercial cattle populations. Even with seedstock level management of genetic defects, commercial cattle producers may still need to cull carrier animals within their herds if the incidence rate of a genetic defect rises to a level where it becomes an economic problem. For more information about beef cattle genetics or specific genetic defects, contact an office of the Mississippi State University Extension Service.