A new angle on the bovine foot

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Abstract

Structural unsoundness of beef cattle is an important issue for producers and contributes to issues of lameness and injury that result in increased treatment, culling and death in the beef cow-calf segment. In recent years, utilization of structural scoring in the form of foot and leg phenotype scores as an evaluation tool for genetic evaluation to assess the structural conformation of beef cattle in many countries including the United States. The different breed organizations in the United States have developed resources for breeders to assess and capture data related to foot and leg scores with utilization varying from within herd culling to expected progeny difference development and utilization within economic selection indexes. Awareness of structural scoring and associated resources by veterinarians as well as a baseline knowledge of utilization within genetic evaluations, management approaches and environmental risk factors that magnify structural unsoundness into lameness and injury events is an opportunity to provide valuable insight and direction to producers in the form of prevention and selection.

Key words: structural unsoundness, foot and leg scores, EPD

Introduction

The importance of lameness and structural unsoundness of beef cattle has long been recognized as an important issue for producers. The most recent National Animal Health Monitoring System (NAHMS) Beef 2017 study that looked at the cow-calf segment of the beef industry demonstrated this with lameness/footrot being the number 1 disease affecting cows, physical unsoundness being the number 3 reason that operations cull animals, and lameness or injury being the number 4 cause of death in breeding cattle.[15] On an individual animal level, an analysis of cases of lameness in beef cattle done in 2016 showed that 85% of lameness originates in the foot, with 70% in the hind limb, the lateral claw being most common and 80% being of noninfectious etiology.[12] Additionally, the most recent National Beef Quality Audit done in 2016 shows that 13% of beef cows and 17% of beef bulls demonstrate some level of lameness at slaughter.[11]

While there is general agreement by most in the beef cattle industry that good foot and hoof structure along with proper skeletal conformation in cattle contribute positively to longevity, reduction of voluntary culling due to conformation, as well as involuntary culling due to injury or lameness, the guidance for appraisal and genetic evaluation of feet and leg structure in beef cattle have only recently been explored.[6] This presentation will attempt to summarize foot and leg phenotypic scoring in beef cattle, how scoring is currently being utilized by various breed associations in the United States, and discuss the potential relevance to veterinary medicine and the practitioner's role.

Structural scoring for foot and leg phenotypic scores

Structural scoring is the assessment of physical characteristics over key areas for genetic evaluation to assess the structural confirmation of the animal.[4] Angus Australia has developed a Paddock Guide to Structural Scoring for Genetic Evaluation available at **https://issuu.com/angusaustralia/docs/structscore_paddockguide.** This resource includes pictures and descriptions on how structural scoring is being approached by members of Angus Australia. The key areas assessed include feet, claw set and foot angle; legs, side and hind view; and udder, evenness, suspension, teat shape and size. This presentation will review feet and leg scoring using the above as an example. The feet and leg scoring used by Angus Australia follows the current recommendations set forth by the Beef Improvement Federation (BIF) that currently recommends, at a minimum, the organization collect claw set/shape and foot/hoof angle using a 1-9 rubric.[6]

For reference, BIF is an organization dedicated to advancing and coordinating all segments of the beef industry. BIF is a resource for producers and associations through performance evaluation targeted at beef improvement that include guidelines for data collection and processing, genetic evaluation and selection and mating. The most prominent outcome of historical BIF efforts is the modern expected progeny difference (EPD), which is the gold standard for genetic selection in the beef industry today.[6]

Claw set/shape

Assessing the shape of the inside edge of each of the claws, on all feet, and the space between the claws. Using a 1-9 scale with 5 being desirable, 1 having open or divergent claws and 9 having scissor claws.[4] Curvature or divergence of claw set/shape disrupts the surface area on the base of the hoof and how weight is distributed.[9]

Foot angle

Assessing the depth of heel present, relative to the angle of the front of the claws on all feet. Using a 1-9 scale with 5 being desirable, 1 having a steep angle to the foot and too much heel and 9 having a shallow foot angle and heel.[4] Shallow-heeled cattle tend to have toes that grow out. Too much heel results in straight pastern angle that limits flexibility of motion.[9]

Rear leg side view

Assessing the angle of the metatarsus bone relative to a vertical line between the pin bone and the ground. Using a 1-9 scale with 5 being desirable, 1 being straight-legged and 9 being extremely angled or sickle hocked.[4] Extremes, either straight or angled/sickle hocked, have negative effects on mobility.[9]

Rear leg hind view

Assessing the angle between the metatarsus and the tibia, as visible from behind. Using a 1-9 scale with 5 being desirable, 1 being bowed out and 9 being bowed in/cow cocked.[4]

U.S. breed association adoption

A review of a selected number of major breed organizations in the United States shows that foot and leg scoring is being evaluated and used in different manners, but with a similar approach. The American Simmental Association has produced a scoring rubric for breeders to use that includes claw shape, foot angle and rear leg side view.[9] The current recommendations to breeders is to use the rubric to help make selection decisions and the association is in the process of collecting data. The Red Angus Association of America (RAAA) is currently focusing on baseline measurements and education of its members. RAAA has developed a foot and leg scoring guide and scoring forms for claw shape, foot angle and rear leg side view.[13] Currently, the resources are targeted for in-herd use with a focus that is for in-herd use of recording data and culling accordingly.[13] The American Angus Association (AAA) developed foot score guidelines that focus on foot angle and claw set.[1] AAA started collecting data in 2015 and developed and released an EPD for both claw set and foot angle in 2019.[14] The claw set EPD (Claw), is expressed in units of claw-set score, with a lower EPD being more favorable indicating a sire will produce progeny with more ideal claw set. The ideal target for claw set being toes are symmetrical, evenly and appropriately spaced. [14] The foot angle EPD (Angle), is expressed in units of foot-angle score, with a lower EPD being more favorable indicating a sire will produce progeny with more ideal foot angle. The ideal targeting animals with a 45-degree angle at the pastern joint with appropriate length and heel depth.[14] Since releasing the foot structure EPDs, the AAA has partnered with Angus Australia and the Canadian Angus Association to combine foot score phenotype data.[8] While this summary is not inclusive of all breed associations, it represents the direction of utilization of structural scoring for feet and legs in the beef breed associations in the United States.

EPDs and indexes

EPDs enable genetic selection decisions for multiple traits, have evolved over the last several decades, and include phenotypic, pedigree and genomic information.[5] While the interpretation and use of EPDs are beyond the scope of this presentation, it should be clear that there are large numbers of EPDs available for each breed association that is producing them. While an individual trait EPD is the best way to compare animals for that specific trait, it is necessary for producers to evaluate animals for genetic merit as it applies to their breeding objectives across multiple traits. As breed associations produce more and more EPDs, the selection process for producers can become more and more difficult to the point of becoming overwhelming. To help with this complexity, many breed associations have developed decision support tools in the form of economic indexes. Economic indexes are a tool used to select for several traits at once based a specific breeding objective. An economic index approach takes into account genetic and economic values as well as the relationships between traits to select for profit, adding simplicity and convenience to a multi-trait selection approach.[3]

The use of indexes by producers, while meant to simplify selection, need to be carefully considered as it is not always clear what the influencing EPDs are within an index. Producers need to choose an index that aligns with their production goals and breeding objectives. For example, the beef value ($B) index produced by the AAA is meant to assist commercial beef producers in selecting for terminal traits and does not incorporate maternal traits or management traits such as claw set or foot angle.[3] While not considering the maternal traits if the producer is truly producing a terminal market calf and not retaining heifers within their herd is a valid approach, there would still be a phenotypic threshold to meet for a bull that was to be used for natural service that included structural soundness.[5] If a bull were not structurally sound, he would be at higher risk for lameness and injury and not be able to pass along the terminal genetics he was selected for, thus devaluing the monetary investment in that individual. It is the opinion of the author that in the race to capture the potential premiums associated with high-quality carcasses, there are examples of decreased structural soundness or the lack of understanding of how to evaluate and select for phenotypic traits affecting structural soundness. It is also worth noting that the impact of structural unsoundness on progeny in the feedlot has the potential to affect their performance and related lameness and injury issues; however, the author did not explore literature on this aspect for this presentation.

Environment/management

One cannot discuss the scoring of phenotypic traits for genetic consideration without acknowledging the impact of environment on genetic expression and the resulting phenotype. This is especially true when discussing feet and leg structure in the bovine. There are many environmental factors to consider and a complete listing is beyond the ability of this presentation to cover.

An example to consider in this is corkscrew claw (CSC). CSC is one of the most common foot conditions that is considered to have a genetic component found in beef cattle lameness cases.[12] A chapter in *Veterinary Clinics of North America* in 2017 by van Amstel, is an excellent review of CSC and its potential genetic and environmental components.[17] The chapter states that CSC heritability is actually quite low, but occurs in association with other more heritable phenotypic traits such as small toe angle, low heels and long/small/narrow claws.[17] Important environmental factors for CSC include housing, season, nutrition, trimming, age and body weight.[17] The reported ideal claw conformation matches with the ideal claw set and foot angle discussed above.

Trends and heritability

While there is work ongoing within multiple breed associations on how to utilize and consider structural scoring for feet and legs in beef cattle, there is indication that both foot angle and claw score are moderately heritable.[10,2] In addition, there is a suggested moderate positive correlation between foot angle and claw score which could allow for simplified evaluations in the future.[10] One study looking at changes in estimated EPDs for foot angle and claw score in a private seedstock operation with data going back to 1992 showed a slight trend toward an improvement in foot angle along with a slight decrease in claw set over that time.[10]

Relevance to veterinary medicine

Beef producers invest significant capital into genetic inputs in their herds. These inputs have immediate effects on calf crop and individual phenotypic issues as well as long-term effects on progeny that can influence a herd for 20-plus years when retaining females. A recent AAA survey of producer preferences for traits that contribute to their success ranked foot score as the third most important behind cow survival and docility and 5 traits higher than any terminal trait such as marbling grade.[7] NAHMS Beef 2017 reported that 40.1% of operations consider

veterinarians very or extremely useful for making decisions related to breeding and genetics.[16] While this percentage was higher than any other source listed on the survey, it leaves lots of opportunity for veterinarians to be involved in or provide information to producers related to breeding and genetics. The ongoing evolution of the use of phenotypic scores for feet and legs in the beef industry is an example of a potential opportunity for veterinarians to help producers interpret an ever-increasing complexity of data related to genetic selection. Along with enhancing the ability to provide more accurate prognosis and recommendations related to structural unsoundness issues and resulting lameness, increased awareness of management and environmental situations that can magnify issues of structural unsoundness allows veterinarians the opportunity to provide valuable input to producers beyond just the treatment and management of lameness and injury.

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