Animal Selection: The Genomics Revolution

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Genomics is briefly defined as the knowledge of the role of genes in relation to their functions. Genomics allows for the estimation of breeding values for young animals from DNA samples through the use of panels of single nucleotide polymorphisms (a type of DNA genetic marker) and this information is used to increase the accuracy of estimated breeding values.

More accurate estimates for young animals should increase the rates of improvement for economically important traits such as carcass traits, pregnancy rates, and longevity. Producers are enhancing their breeding programs by using DNA testing and beef genomics to diagnose and screen for genetic health issues, selection of animals to calve, result in herd improvement, and identification of parentage of offspring when using multiple sires in a pasture. Determination of DNA is accomplished by measuring DNA in hair follicles, blood, semen, or tissue, followed by detecting gene markers in the DNA and then comparing these markers to phenotypes of thousands of animals.

In a survey reported by Kansas State University, it was found that many cow-calf producers will seek advice from veterinarians, extension faculty and seedstock producers about beef genomics because they generally had a low level of understanding about genetic selection tools and the anticipated benefits from inclusion of genomic data into genetic evaluation programs. The survey results also suggested that profitability incentives were key to producer interest in this new technology.

There are several reasons seedstock and commercial cattlemen are genetic testing: 1) diagnosis and screening for genetic abnormalities; 2) analysis for traits affecting fertility, calving ease, live birth and growth/ performance factors; 3) finding genetic conditions favored in the market such as horned/poll, black coat, tenderness, etc.; 4) verification of parentage; 5) development of genomic-enhanced EPDs for seedstock; and 6) profiling of commercial replacement heifers for genetic traits such as stayability and pregnancy rate.

One example on how the genomic information has become a part of a selection index are the results from the King Ranch from Texas which uses a genomic profile and other data to create a calf value index, which incorporates EPDs, genotypic information, phenotypic information and economic value. Economic value is created by applying more breeding pressure to traits based on the local environment and the importance of these traits to the success of the ranch.

• Seedstock producers use genomic testing to do the following:
  • Profile sire prospects when they are young
  • Market accurate genomic-enhanced EPDs (GE-EPDs) on young sires
  • Retain best heifers for future bull production and sell lower quality heifers
  • Focus feed and resources on profiled seedstock
  • Predict traits that are a challenge to measure such as fertility and stayability
  • Enhance value of young animals

For the commercial cattlemen who focuses on building a more productive herd, the goals include having fewer calving problems, identification of heifers with higher conception rates, identification of cows that don’t breed back, removal of cows with poor docility and identification of cows that produce too much or too little milk.

One example of how you could use the technology is to assume the following: Pinpoint a weakness such as improving the conception rates in 2-year-old heifers. First, use genomic technology to profile heifers at weaning and finally once to two generations of selected heifers to improve conception rates. Being able to predict how heifers will pass on economically important traits to their offspring will dramatically improve the quality of a cow herd.

Genomic technology allows the producer to screen replacement heifers at a reasonable cost for traits such as calving ease maternal, heifer pregnancy, docility, milk, average daily gain, and marbling. In addition, producers can use the technology to determine parentage of the offspring when multiple sires are in a pasture in order to identify which bulls did the majority of the breeding and also which traits were passed on to heifers. The following graph provides an example of the number of calves sired by eight yearling bulls. Bulls 407 and 594 appear to be underperforming while bulls 405 and 501 bred the most females. Interpreting these results allows the rancher to identify sires with the most and least calves, or dominant breeding behavior, and ultimately identifying the best and poorest replacement heifer candidates.

Remember that the efficiency of traditional breeding methods decreases when the traits become difficult to measure or have a low heritability or cannot be quickly, inexpensively and correctly measured in a large number of animals. Difficult to measure traits include fertility, longevity, feed efficiency and disease resistance. Selection for several of these traits can now be achieved through the use of genomic technology.