# Facilitating profit-driven breeding for commercial cow-calf producers

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## Abstract

Sire selection is one of the most critical decisions that a commercial beef cattle operation makes. Many producers look to their veterinarians for advice on genetic selection decisions. Developing a profit-aligned breeding goal is essential in setting up an operation for success. Breeding goals should consider marketing endpoints and opportunities for producers to reduce animal maintenance and development costs. Each producer is different, so breeding goals must be appropriate for the producer's environment and management level. A wealth of selection tools exist for producers to maximize genetic progress and reduce risk. Using expected progeny differences (EPDs) for selection allows producers to focus selection on an animal's estimated genetic merit. This reduces risk and increases the rate of genetic progress. Breed associations report EPDs on dozens of economically-relevant traits. Selection indices have been developed to weight trait predictions by their economic importance and simplify the selection process. Using an index well-aligned with the breeding goal allows producers to select for increased profitability using a single value. These selection tools, combined with effective phenotypic evaluation, can enhance the ability of producers to make an effective bull selection decision.

**Key words:** genetics, breeding, selection

## Introduction

Veterinarians are essential partners for producers beyond consulting on animal health issues. Sire selection is one of the most consequential decisions that a commercial cattle operation makes. The consequences of a poor decision can have both immediate and long-term effects on a herd. This is especially true when they retain replacement females. Ensuring that veterinary practices are well-equipped to provide data-driven selection decision support to their clients is of great importance. This review discusses the importance of developing a breeding plan for commercial producers and the current genetic selection tools available to producers.

## Developing a breeding plan

Before a commercial producer makes any sire selection decisions, they must have a thoroughly developed set of breeding goals to work towards. The objectives of any breeding program should be to generate genetic progress on the traits that are important for profitability, sustainability, or welfare.[2] This means that when developing breeding goals, it is vital to consider not only revenue sources such as weaned calf weight or red meat, but also those that impact the overall profitability of a cowherd. These might include cow-focused traits like longevity, fertility, or maintenance requirements.

Understanding how and where a producer markets their calves is essential for developing an effective breeding plan. Producers who retain ownership of their calves through the feedlot and market on a merit-based grid will want to focus their selection decisions on a different set of traits than those who sell calves at weaning. The same goes for producers who keep replacement females. It is also essential to consider an operation's resource availability. Cows that are heavy milking may wean off slightly heavier calves, but they will also have higher maintenance requirements.[1] Operations with low-quality forage resources will not allow cows to achieve their full genetic potential for calf production. In addition to sustained genetic progress on traits that affect the profitability of an operation, a careful accounting of the herd's strengths and weaknesses can help inform breeding goals. Special attention can then be directed towards the traits that require more substantial improvements.

## Crossbreeding

Once a herd's breeding goal has been developed; it is important to choose a corresponding crossbreeding program. Crossbreeding benefits commercial cowherds in two main ways; breed complementarity and heterosis.[4] Breed complementarity allows breeders to match the additive strengths of one breed with the additive strengths of another. This might be matching Angus' heavy marbling with the lean growth potential of a Charolais to make an excellent terminal cross. Heterosis is when non-additive genetic effects allow crossbred offspring to outperform both parental lines.[4] Heterosis results in what is effectively "free" performance across traits. The effects of heterosis are greater for low heritability traits like cow longevity, fertility and health.[2] This means that crossbred cows make exceptional replacement females for commercial operations.

Crossbreeding programs range in complexity from 2 breed terminal crosses to multi-breed rotational schemes. More complex systems result in greater retained heterosis in subsequent generations.[7] When developing a crossbreeding plan with a producer, much will depend on the size of their operation as more complex rotations require multiple breeding pastures and additional bull power. With crossbreeding programs, order matters. Before producers choose sires, they must understand which breed is needed in their crossbreeding program.

## EPDs

Once producers have settled on a breeding goal and a logical crossbreeding program, it is crucial that they utilize the full range of selection tools to make breeding decisions. Beef cattle breed associations report expected progeny differences (EPDs) for various traits. EPDs use a mixed linear model to estimate the genetic potential of animals for a given trait after removing variation due to environment and management.[6] EPDs can be calculated for any heritable trait measured on a large enough cohort of related animals within a population (i.e., a breed with a large pedigree).

EPDs are designed to compare animals within the same population or a single animal to the population average. In general, we can interpret an EPD as the average number of trait units (lbs., inches, percentage, etc.) difference between 2 animals' offspring. For example, when comparing 2 sires with weaning weight EPDs of 20 and 45, we expect the second sire to wean off calves that were 25 pounds heavier on average than calves from the first sire. The units of measurement will differ based on the trait being predicted, but the interpretation remains the same. Individual EPD values are not helpful unless compared between individual animals or the breed average.

Since EPDs are statistical predictions of genetic merit, they tend to change as additional information is added to a genetic evaluation. This additional information generally comes from records on progeny or relatives. Recently, genomics has allowed us to increase the accuracy of EPDs for animals without progeny.[3] This boost in accuracy is especially important for reducing the risk of purchasing young, unproven bulls. Depending on the trait, a genomic test can add the same accuracy as between 10-35 calf records. As genomic testing costs have declined, most seedstock producers provide their bull buyers with genomically-enhanced EPDs (GE-EPDs). Bulls without GE-EPDs should be considered with caution. Across breeds, EPDs are calculated on various traits that impact an operation's profitability. These include traits related to calving ease, pre- & post-weaning growth, maternal ability, cow longevity, docility, feed efficiency and carcass traits. Which EPDs a producer utilizes in selection decisions will depend on their breeding plan.

## Selection indices

In almost all cases, operations work to make genetic progress on multiple traits at once to maximize profitability. Issues may arise when balancing the relative economic importance of many traits that might also be genetically correlated. One solution to these challenges is to use economic selection indices.[5] Selection indices weight EPDs for individual traits by their relative economic importance in a generalized production scenario. This enables selection for animals likely to have the most profitable offspring based on their aggregate genetic merit across economically relevant traits.

Indices are developed using costs and income estimates for generalized production schemes. Breed associations calculate indices that fall into 3 main classes, maternal, terminal and all-purpose. Maternal indices assume that the user will retain replacement females and market remaining calves at weaning. This index type will emphasize calving ease, cow longevity, cow efficiency and weaning weight. Terminal indices assume that a producer will not retain replacement females and that they will retain ownership on all calves and market them on a merit-based carcass grid. These indices place heavy economic weights on post-weaning gain and carcass traits like ribeye area, marbling and carcass weight. All-purpose indices assume that an operation will both retain females and market their calves on a carcass-based grid. As a result, they will emphasize maternal and terminal traits. Producers should choose indices that are well-aligned with their overall breeding goal. Failing to do so may result in a lack of genetic progress on the traits essential to the herd's profitability.

## Conclusions

Veterinarians are essential partners in advising commercial producers on their genetic selection decisions. In every case, it is necessary to develop a breeding plan before sire selection. A breeding plan should also prioritize identifying the optimal crossbreeding combination that takes advantage of breed complementarity and heterosis. Using EPDs, genomic testing, and selection indices, producers can identify the sires that will generate the most rapid genetic progress toward their breeding goals. When using these tools to select a bull, order matters. Selection indices should be used to identify a top tier of bulls for an operation's generalized production scheme. EPDs can then be used to identify the top bulls with the greatest genetic potential to improve specific traits central to an operation's breeding goals. Finally, the use of genetic selection tools does not negate the need for a sound phenotypic evaluation. Bulls that are unsound, aggressive or hard to maintain will not effectively serve a herd. The sire selection process has far-reaching impacts on the profitability of a herd. As such, it deserves ample attention and a data-driven approach.

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