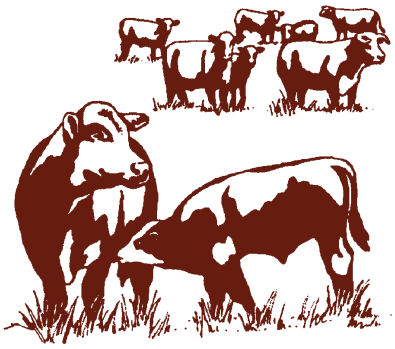

Beef Cattle Handbook

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Understanding Performance Pedigrees

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Beef cattle breed associations annually accumulate hundreds of thousands of beef cattle performance records from breeders across North America. These records provide beef producers with a powerful management tool to make selection decisions regarding replacement animals for herds. They are used to calculate the genetic merit of animals represented in the breed, and this vast amount of information, coupled with new computer and statistical technology, has enabled breed associations to produce performance pedigrees for virtually every animal in the breed.

A performance pedigree summarizes a particular animal's own performance records as well as records of ancestors, half and full sibs, and progeny. Performance information is provided in addition to the pedigree information. Breed organizations systematically combine performance information and list expected progeny differences (or breeding values) on the pedigrees. Consequently, performance pedigrees bring traditional ancestral pedigrees to life by presenting meaningful data in a logical format. The information in performance pedigrees is useful to both commercial and seedstock producers for making selection decisions regarding both male and female replacement animals.

Genetic Evaluation—Expected Progeny Differences

Performance pedigrees are particularly meaningful because of values known as expected progeny differences (EPD). An EPD is used to express the genetic transmitting ability of an animal and is a measure of the genetic value (superiority) of that animal. An EPD is an indication of the amount of genetic merit that the animal will pass to its offspring. EPDs are reported by breed associations as a plus or minus value in units consistent with the trait measured, such as pounds for weaning weight. For example, a bull with a weaning weight EPD of +25.0 lb would produce progeny that should average 25.0 lb more at 205 days of age than progeny of a bull with an EPD for weaning weight of 0.0 lb when bred to a comparable group of cows. Likewise, a bull with an EPD for birth weight of +5.0 lb would produce progeny that should average 5.0 lb more at birth than progeny of a bull with a birth weight EPD of 0.0 lb.

Within-breed EPDs can be used to compare and rank animals within an individual herd or breed, but can not be used to compare animals across breeds. An EPD of +10 lb for weaning weight in one breed may reflect an entirely different level of genetic merit than a +10 lb weaning weight EPD in a different breed.

EPDs for a given trait are calculated using the animal's own performance records and the performance of ancestors, half and full sibs, and progeny. Consequently, an animal's EPD for a given trait is the single best estimate of the animal's genetic merit for the trait because all known information on the animal and all of its relatives are used in the genetic evaluation procedure. EPDs for young nonparent animals, with no individual performance measures, are calculated solely on the performance of their ancestors. However, as individual and progeny performance records become available, the amount of weight given the ancestors' performance lessens and more emphasis is put on the animal's own performance and the performance of its progeny. Animals are re-evaluated periodically as more records are added to the breed performance data base.

Accuracy of EPDs

The amount of information used in the estimation of an EPD is reflected in the accuracy (ACC) value for the trait. As more information becomes available, the accuracy of the EPD will increase and the relationship between the EPD and the animal's true genetic merit becomes stronger. As would be expected, the ACC values for non-parent animals are lower because fewer records are available for use in genetic evaluation.

Accuracy values for all traits range from zero to one. The higher the accuracy value, the stronger the relationship between the EPD and the actual genetic merit of the animal. Sires will usually have higher accuracy values than cows because of the relative number of records produced. For example, some AI bulls sire thousands of calves in their lifetime, while most cows produce fewer than ten calves.

Classification of EPDs

EPDs may be classified as either direct or maternal. Direct EPDs predict traits of the sire, while maternal EPDs predict traits of the sire's daughters. The differences between direct and maternal EPDs also relate to the sources of data used in their calculation. Direct EPDs are calculated for calving ease, birth weight, weaning weight, yearling weight, scrotal circumference, gestation length, etc. Maternal EPDs are calculated for calving ease traits, milk and weaning weight. However, not all breed associations calculate EPDs for each of these traits.

Direct calving ease EPDs are an estimate of calving ease as a trait of the sire or the calf's ability to be born. Maternal calving ease EPDs are an estimate of calving ease as a trait of the dam or the cow's ability to have a calf. Direct and maternal calving ease are indeed different and should be treated as two separate traits. Birth weight EPDs are an estimate of genetic merit for birth weight and may be used as a predictor of direct calving ease.

Two genetic factors have impact on the weaning weight of a calf; the genetic merit of the calf for growth rate (direct), and the genetic merit of the dam for milk production (maternal). Direct weaning weight EPDs are the best estimate of preweaning growth, while milk EPDs are the best estimate of genetic merit for the dam's maternal influence (primarily milk-producing ability) on progeny weaning weight. Some breed associations calculate maternal weaning weight EPDs (total maternal) in addition to a maternal milk EPD. The maternal weaning weight EPD includes one-half of the direct or growth effect on weaning weight and all of the maternal or milk effect.

Information Used to Calculate EPDs

Direct EPDs are calculated by combining several sources of information: individual records, full sibs, paternal half-sibs (brothers and sisters by the same sire); maternal half-sibs (brothers and sisters out of the same dam); and progeny information. The individual's record comes from one herd. Normally, the maternal half-sib (MHS) data come from one herd unless the dam changed ownership. However, paternal half-sibs (PHS) and progeny records for some sires are accumulated from numerous herds that used the sire and submitted performance data to the breed association.

The number of performance records collected across herds adds significantly to the accuracy of the EPDs. For example, performance records on 20 paternal half-sibs are about equal to the individual's own performance data in terms of the effect on the accuracy of the EPD. However, records on 20 progeny comprise 70% of the influence on the EPD (and accuracy) for a sire with an individual performance record and an additional 20 half-sib records.

Maternal EPDs are calculated for a sire using the calving ease scores or weaning weight records of the progeny of daughters of his sire, daughters of his paternal grandsire, daughters of his maternal grandsire, and daughters of the sire himself. If the animal is a young bull with no daughters in production, his dam's progeny information is substituted for his daughters' progeny records. However, the single most important source of information contributing to the maternal EPD of a proven bull is his own daughters' progeny records.

Performance Pedigree Information

Each breed association uses a unique format for its performance pedigrees. However, the information contained in the pedigrees is similar across all breeds. Typically, a performance pedigree lists a conventional three-generation pedigree including the animal's sire and dam and complete pedigree information for both grandsires and grandams. Other information listed includes the animal's name, breeder, sex, identification, date of birth, and registration number.

The advantage of a performance pedigree is that it expands on the conventional pedigree information and provides a detailed summary of the performance of the animal. Performance pedigrees differ in the amount and presentation of information, but all include EPDs for all traits evaluated on the individual, sire, and dam. For example, most performance pedigrees list EPDs for birth weight, weaning weight direct, maternal milk and yearling weight for the individual animal and the sire and dam. Other EPDs also may be listed. For example, maternal weaning weight (milk plus growth), calving ease, scrotal circumference and/or carcass traits are listed on some breed performance pedigrees.

Other performance information is included on a performance pedigree in addition to the trait EPDs. Most performance pedigrees list a summary of average performance values or ratios for the pedigreed animal and the sire and dam. For example, a performance pedigree for an Angus bull includes individual calving ease scores and the contemporary group sizes and ratios for birth weight, weaning weight, and yearling weight for the individual bull, sire, and dam. In addition, the performance pedigree for an Angus bull also lists progeny averages for calving ease, weaning weight, yearling

weight, maternal calving ease, and maternal weaning weight, and includes the number of herds or contemporary groups and number of progeny in each score or ratio. Progeny averages are listed for the pedigreed animal, sire, dam, paternal grandsire, and maternal grandsire. Angus performance pedigrees also include EPDs for carcass weight, marbling, and rib eye area, and list average carcass weights for animals with carcass EPDs. American Hereford Association performance pedigrees list average birth weights for progeny and average frame scores but do not currently include any carcass performance information or carcass trait EPDs. Most breed organizations list similar performance statistics with variations in individual trait summaries.

Using a Performance Pedigree

Performance pedigrees have many applications for breeders or producers making selection decisions. The advantage of a performance pedigree is that both pedigree and performance information are summarized in an efficient, organized manner. EPDs are listed for the animal, sire, and dam, enabling producers to analyze the performance of the animal and its direct ancestors. Performance pedigrees also contain summary information for the average actual performance of an animal and its progeny within individual herds or contemporary groups.

The complete EPD summary provided by the performance pedigree has many applications for selection decisions made by beef producers. Information provided by a performance pedigree is useful when evaluating sires in addition to EPDs in the breed sire summary. Some performance pedigrees provide additional EPDs for traits not listed in the sire summary.

For many beef producers, the most useful application of a performance pedigree is the evaluation of young bulls or cows as possible replacement breeding animals. Young bulls and most cows often have little or no progeny information available and consequently have EPDs with relatively low accuracy levels for many traits. Many young bulls are not listed in the breed sire summary. The pedigree and ancestor performance information provided by a performance pedigree is of value to a producer when making selection decisions regarding young animals or females. In addition, the listing of the number of herds or contemporary groups in which a bull has offspring gives an indication of how widely the bull has been used and the number of records collected for the bull. Since sire summaries are computed and published only once or twice a year for most breeds, performance pedigrees often provide the most up-to-date performance information available for making selection decisions.

Stacking Pedigrees for Consistent Superior Performance

Breeders often use performance pedigrees and sire summaries when stacking pedigrees to create lines of genetically superior animals. How might a breeder use sire summary data or performance pedigrees to effectively build a superior herd? It is done by using bulls in succession that excel in the same traits. In other words, breed the best to the best. For example, if you want to improve the genetic merit level for yearling weight in your herd, breed bulls with high yearling weight EPDs to daughters of bulls with high yearling weight EPDs.

A pedigree for yearling weight has been stacked in Figure 1. Great Expectation is the calf that will hopefully be produced. His maternal grandam was Average Cow. She was bred to Good Ole Bull who has a yearling weight EPD of +50.0 lb. This mating produced Decent Cow. Based upon principles of inheritance, the average calf from this mating would have a yearling weight EPD of +35.0 lb [EPD of Decent Cow = 1/2 x (EPD of Good Ole Bull) + 1/2 x (EPD of Average Cow)]. In the next generation, breeding Decent Cow to Better Bull produces Great Expectation. Better Bull has a yearling weight EPD of +65.0 lb. This kind of mating would, on the average, be expected to produce calves that would have a yearling weight EPD of +45.0 lb [45 lb = 1/2 x 65 lb (EPD of Better Bull) + 1/2 x 25 lb (estimated EPD of Decent Cow)]. The EPD values of both the sire and dam have been halved because they each contribute only one-half of their genetic makeup to their offspring.

If a large number of calves are produced from such a mating, one would expect them to have an average yearling weight EPD of +45.0 lb. However, some variation will exist in the EPD values. Some calves would have EPD values greater than +45.0 and some would have EPD values less than +45.0 lb. Based upon statistics, it is known that nearly 68% of the calves would have EPD values from +30.0 to +60.0 lb and 95% would have EPD values from +15.0 to +75.0 lb for yearling weight. Likewise, less than 2.5% would have an EPD in excess of +75.0 lb for

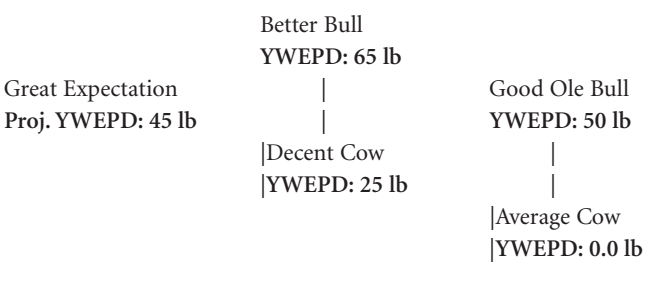

Figure 1

yearling weight and fewer than 2.5% would have an EPD less than +15.0 lb. Stacking pedigrees offers a tremendous opportunity to build genetically superior cattle when breeders use EPDs correctly.

The projected EPD values for yearling weight calculated in the preceding paragraph for Great Expectation is an example of what is called a pedigree index. When nothing is known about the calf except the EPD value of his sire and maternal grandsire, a pedigree index value can be calculated that becomes the best estimate of his genetic merit. Information on the production record of the dam and Great Expectation's own performance record can also be used to improve confidence in the evaluation of Great Expectation. This information is

included in a performance pedigree. Figure 2 shows the effect of inappropriate sire selection on average breeding values in a herd.

For example, take Decent Cow in the previous example and breed her to Breeding Disaster who has a yearling weight EPD of -19.0 lb. One would expect to produce progeny that would, on the average, have a yearling weight EPD of +3.0 lb. Producers frequently make matings such as the one that produced Decent Cow. However, because their selection goals change, or another trait becomes more important to them, they often use bulls on these females that are below average in genetic merit for growth rate. When sire selection is not effective, progress is slowed and often reversed.

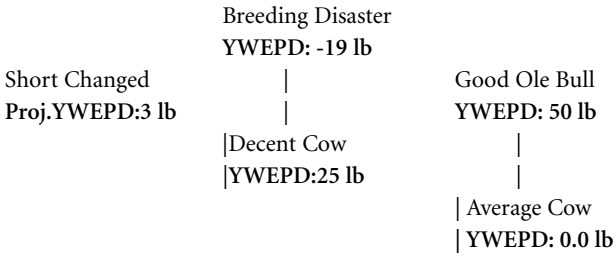

Figure 2

Selection for only one trait in a breeding program can be a problem because of undesirable genetic correlations. Therefore, "stacking pedigrees"—using the principles of single trait selection—could cause some unwanted problems. For example, there is a positive genetic correlation between yearling weight and birth weight. This means that selection for yearling weight will also increase birth weight if no negative emphasis is placed on birth weight. Birth weight is highly related to calving difficulty. A producer who is only interested in producing high EPD values for yearling weight might also generate high EPD values for birth weight if he selects sires strictly on their yearling weight EPD values as illustrated in Figure 3.

The problem occurs because there is a distribution of EPD values around the expected average. In Figure 3, the projected EPD for birth weight is 5.0 lb, but 68% of the calves from this mating would be expected to have a birth weight EPD of +3.4 to +6.6 lb. While selection for higher yearling weight EPD has been successful, an increase in birth weight EPD has also occurred due to the positive genetic correlation between these traits.

All genetic correlations between economically important traits should be considered if a breeder

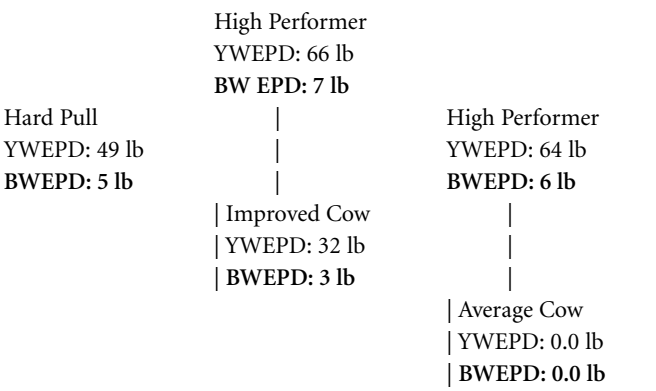

Figure 3

decides to conduct a breeding program designed to stack pedigrees for a single trait. Be aware that other traits may be positively or negatively affected and may impact the overall genetic or economic value of the herd.

EPDs make multiple trait-selection easier. By stacking pedigrees for animals that have acceptable birth weight EPDs and moderate to high growth EPDs, it is possible to develop lines of cattle that are uniform in kind with relative calving ease and high growth rate performance. The same principles apply to many other combinations of traits. Stacking pedigrees in this manner allows the breeder the opportunity to focus on more than one trait of economic importance.

Summary

The use of accurate EPDs for economically important traits is important to the beef producer. To continue genetic improvement in a herd, each new sire or group of sires should be superior to the last one used. Continuous genetic improvement requires a strict breeding plan with well-defined goals and long term commitment to the plan. Using performance pedigrees and stacking pedigrees of genetically superior animals will provide the basis for an effective breeding plan. Performance pedigrees allow cattlemen to evaluate and compare animals for many traits of economic importance to the enterprise. Performance pedigrees and EPDs for specific traits will enable the beef producer to consistently identify and incorporate genetically superior animals into the breeding herd. Remember, the effects of using a poor bull in a herd will be evident for several years. Performance pedigrees provide producers with accurate, reliable information on which to base selection decisions and produce uniform, consistently superior animals.

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