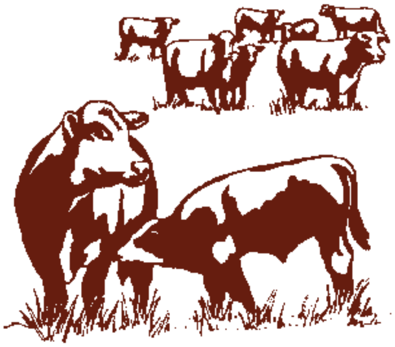
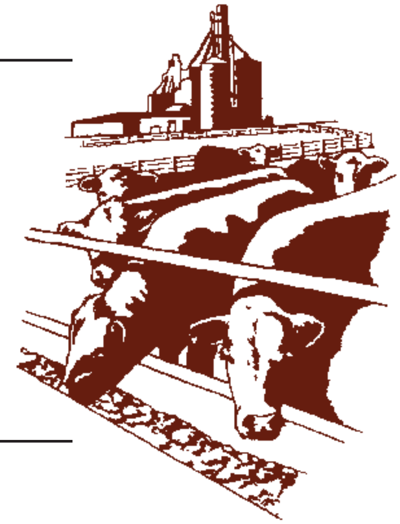


Beef Cattle Handbook



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Understanding and Using Across-breed Expected Progeny Differences (EPDs)

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Introduction

For years, animal scientists have told purebred and commercial cattle producers that expected progeny differences (EPDs) should not be compared *across* breeds because they were developed as a measure of genetic merit for comparison *within* breeds. However, recent research now provides commercial producers with the ability to compare bulls of one breed to those of another breed in a quantitative manner, providing them with an additional tool to achieve breeding goals that are part of their crossbreeding systems.

Initial research and development work on across-breed EPDs was a major part of the program at the Beef Improvement Federation meeting in 1989. At that meeting, Notter (1989) discussed the pros and cons of developing a system that would allow comparison of cattle across breeds. The purpose of this fact sheet is to help beef cattle breeders to understand and use across-breed (AB) EPDs. Understanding how to use both within- and across-breed EPDs is important for the successful production of beef cattle with the genetic potential to excel in their production system.

Brief Review of Within-Breed EPDs

A brief review of within-breed EPDs will help set the stage for discussing AB-EPDs. Some producers may find it beneficial to review an in-depth article on EPDs prior to learning about AB-EPDs.

EPDs provide a quantitative measure of an animal's genetic merit. The difference between the EPDs of two bulls for a specific trait is the expected difference in average performance of future progeny sired by the two bulls, assuming both bulls are bred to a comparable group of cows. An EPD is a prediction of one-half an animal's genetic merit that is transmitted to its progeny, usually reported in units in which the trait is measured. Information on the individual, its relatives, and progeny are used in computing an individual's EPD. Because calves do not yet have progeny, their EPDs are based on pedigree information and their own performance. Thus, the emphasis on each type of information in computing an individual's EPD shifts as the animal gets older and has progeny. Best linear unbiased prediction (BLUP) methods are used to compute EPDs and account for: 1) environmental and management differences among contemporary groups; 2) genetic merit of mates; 3) performance of the animal and its relatives and progeny; and 4) genetic trend.

Currently, EPDs obtained from breed associations can be used for within breed comparisons. However, calculation methods have been developed to allow comparisons across breeds. Following is a discussion of the methods used to compute and use adjustment factors required to calculate AB-EPDs.

Breed Differences in National Cattle Evaluation (NCE)

Several differences existed in NCE among breeds when the concept of AB-EPDs was first developed. These differences were due to differences in: 1) models used for genetic evaluation; 2) genetic parameter estimates; 3) adjustments for fixed effects; 4) base years; and 5) use of records from non-purebred animals. Fortunately, differences in NCE programs have diminished over time.

Standardization of NCE programs is one of the goals of the Beef Improvement Federation's Genetic Prediction Committee.

Across-Breed EPD Development and Current Methods

Initial discussions of AB-EPDs met with considerable resistance, a common occurrence with new technology. However, although some breed associations and breeders are concerned about how AB-EPDs may be used, generally, they have encouraged research and development of this genetic tool because of its value to many commercial producers. While the question of accuracy of AB-EPDs is important to ask, few people would question that they are more accurate than existing methods of comparison. Commercial beef cattle producers have been making across-breed comparisons since crossbreeding was shown to have certain advantages over purebreeding. AB-EPDs are the result of a scientific approach to making those comparisons, not unlike that which many successful beef cattle producers have come to depend on with EPDs.

Data from the Germ Plasm Evaluation (GPE) program at the US Meat Animal Research Center (MARC) have been used to compute the adjustment factors required to calculate AB-EPDs. The GPE study has involved 26 breeds in five cycles; however, only the 12 breeds with current NCE programs were included in the analysis. Previous across-breed analyses demonstrated that within-breed EPDs can be used to adjust breed comparisons for genetic trends and sire sampling (Notter and Cundiff, 1991; Nunez-Dominguez et al., 1993). Since those analyses, additional breeds have conducted NCE programs and additional sires and breeds have been used in the GPE program as part of Cycle V. Only progeny of sires with current genetic evaluations are included in the analysis (Barkhouse et al., 1994). The final data set included birth weights (n = 4,669), 205-day weaning weights (n = 4,245), and 365-day yearling weights (n = 3,952) of F1 calves by 12 sire breeds mated to Angus and Hereford dams (Van Vleck and Cundiff, 1996). Analyses of maternal weaning weight and milk used 205-day weaning weights of 6,697 three-breed-cross calves produced by mating 1,564 F1 females to different sire breeds.

To avoid confounding of additive breed effects with general effects of heterosis and breed maternal effects, sires were mated to dams of different breeds; thus, straightbred and backcross progeny records are not used (Barkhouse et al., 1994). In addition, the maternal evaluations were based on outcross progeny (i.e., 3-way cross calves). Analytical procedures currently used are described by Van Vleck and Cundiff (1996). The initial model estimated sire breed effects for each trait. Then, calf performance for each trait was regressed on the sire EPD (from NCE) for that trait. Breed differences were adjusted to a 1994 base because yearling weights were available on calves born in 1994 and would have been used in the 1996 NCE for each breed.

Cundiff (1993) stated that each year estimates are more consistent with expectations based on previous experimental results than estimates presented by Nunez-Dominguez et al. (1993) or Notter et al. (1991). There are two primary reasons: 1) many more records become available each year for most breeds; and 2) many records on maternal performance of daughters of sires used at MARC in the mid-to-late 1980s are just now being added to the databases at MARC and those of the breed associations. Thus, the accuracy of maternal weaning weight and milk EPDs has increased for many of the sires used at MARC.

Finally, some caution may be needed in predicting performance of crosses that differ from the F1 and 3-way crosses produced at MARC, because the current methods used assume that hybrid vigor (heterosis) is the same in all crosses. This assumption is reasonable for British and Continental breeds, but is probably less acceptable when comparing Continental and Brahman crosses. Thus AB-EPD adjustment factors for Brahman cattle likely include a breed effect plus the greater hybrid vigor of Brahman crosses. This value would be appropriate for most situations using purebred or crossbred Brahman bulls to produce crossbred calves, but may overestimate the merit of purebred Brahman calves relative to other purebreds and crosses.

Calculating AB-EPD Adjustment Factors

Values used to calculate AB-EPD adjustment factors, which are necessary before calculation of AB-EPDs for individual sires, are published in Van Vleck and Cundiff (1996). The analysis is done every year with current data and is included in the Beef Improvement Federation annual meeting proceedings. Adjustment factors for each trait and breed in 1996 were calculated as:

$$\begin{matrix}\text{Adjustment} \\ \text{factor for} \\ \text{breed } i\end{matrix} = \left(\begin{matrix}\text{1994} \\ \text{Mean for} \\ \text{breed } i \\ \end{matrix} - \begin{matrix}\text{1994} \\ \text{Mean for} \\ \text{base} \\ \text{breed}\end{matrix}\right) - \left(\begin{matrix}\text{1994} \\ \text{Mean EPD} \\ \text{for} \\ \text{breed } i\end{matrix} - \begin{matrix}\text{1994} \\ \text{Mean EPD} \\ \text{for base} \\ \text{breed}\end{matrix}\right)$$

By using Angus as the base breed, it simply becomes a reference breed to compare/scale other breed EPDs.

The adjustment factor for a breed and trait is added to the within-breed EPDs to calculate AB-EPDs (adjusted to a common genetic base) that can be compared directly to EPDs for the base breed for each trait or any bull with AB-EPDs adjusted to the same base breed. Thus, EPDs can be compared across breeds as long as the values are on the same scale!

Adjustment factors in Table 1 should *not* be used to compare breeds because the genetic base (reference point) for different breeds is not the same year for every breed.

Choosing a Base Breed

The Angus breed was previously chosen for use as the base breed because they have millions of records that are used in their NCE. Angus cattle are also found

Table 1. Across-breed Adjustment Factors Using Angus as the Base Breed

				Maternal	
Breed	BWT	WWT	YWT	WWT	Milk
Angus	0.0	0.0	0.0	0.0	0.0
Hereford	5.3	9.8	9.1	-1.2	-5.7
Shorthorn	8.9	28.7	40.7	26.5	12.1
Brahman	15.6	39.9	-9.7	45.9	25.9
Simmental	11.9	55.7	91.2	55.9	28.0
Limousin	8.3	35.5	35.0	12.4	-5.4
Charolais	10.9	43.2	65.3	25.4	3.8
Maine-Anjou	12.8	38.8	51.9	41.7	22.3
Gelbvieh	10.6	47.2	52.4	49.6	22.3
Pinzgauer	9.6	33.0	34.3	28.9	12.4
Salers	7.1	28.9	36.5	29.1	14.6
Tarentaise	6.0	33.1	18.5	37.3	20.7

throughout the US in purebred and commercial herds. Although any of the breeds included in the analysis may be chosen as the base breed, less confusion will result if one breed is chosen as the "standard" base breed. Establishment of a base breed will allow producers to determine optimum ranges in AB-EPDs for the various traits of production that are best suited for their resources and environment. Varying the base from one producer to the next is likely to cause confusion.

Accuracy of AB-EPDs

Unfortunately, a method for calculating AB-EPD accuracy values is not possible. The reason is that the difference in AB-EPDs between two bulls contains the across-breed adjustment factor (Van Vleck, 1993). The across-breed adjustment factor is the best, although not a perfect, estimate of the difference in EPDs due to the breed differences (Van Vleck, 1994). The adjustment factors have what are called sampling variances, even though they are based on a relatively large number of sires and their progeny for each breed. The sampling variances of the adjustment factors contribute to what is called a confidence range on the difference in AB-EPDs for a pair of bulls. A complete description of this calculation is beyond the scope of this fact sheet. The sampling variances of the adjustment factors; however, do not add much to the confidence range beyond what the accuracy (reliability) values of the two bulls contribute. Until a consensus is reached, a practical solution is to rely on the accuracy values reported with the within-breed EPDs. The within-breed EPD accuracies would lead to a slight underestimation of the confidence range for the difference in a pair of AB-EPDs.

AB-EPD Examples

The adjustment factors can be used to calculate AB-EPDs for the growth and maternal traits. Five A.I. bulls were chosen to demonstrate how to compute AB-EPDs with Angus as the base breed. The first row of numbers in Table 2 for each bull gives his EPDs from the fall 1996 sire summary (Hereford is spring 1996) for his breed. The second row of numbers is his AB-EPD on an Angus scale. The equation used to calculate the AB-EPDs in Table 2 follows:

AB-EPD = Adjustment factor + within-breed EPD

A numerical example for the Gelbvieh bull, Polled Summit, follows:

Birth weight AB-EPD on Angus scale = 10.6 (from Table 1) + 1.6 (from Table 2) = 12.2 lb

The Future of AB-EPDs

Those who still question whether AB-EPDs will be used probably also thought that new methodology to calculate within-breed EPDs was not needed. However, in our discussion of AB-EPDs, some reasonable doubts were based on the following: 1) limited numbers of animals per breed evaluated at MARC suggested low accuracy; 2) the adjustment factors were based on research conducted under the environmental conditions of MARC in Nebraska; 3) bulls sampled/used at MARC might not have been representative of their respective breeds; 4) the five traits analyzed may not provide sufficient information upon which to select bulls/breeds; 5) confusion about the concept and calculations might cause improper use of AB-EPDs and breed rankings; and 6) accuracy values were not available for AB-EPDs on a 0 to 1 scale as with EPDs.

These questions have been addressed through research and changes in the methodology used. The number of records used for these analyses by MARC researchers increases each year. In addition, a research project is underway to use records of crossbred cattle from other research institutions. Scientists involved in regional research project NC-196, Genetics of Body Composition, are part of that effort. Some large private herds in the US may have records that can be included in the analyses. Several breed associations also maintain

Table 2. Example Demonstrating Within- and Across-breed EPDs for Five A.I. Sires

Bull/breed	EPD	BWT	WWT	YWT	Maternal WWT	Maternal Milk
Hoff Hi Spade SC491	Angus EPDs	3.4	42.0	74.0	35.0	13.0
Angus	Angus scale[a]	3.4	42.0	74.0	35.0	13.0
Feltons 468	Hereford EPDs	2.8	17.0	36.0	13.0	4.0
Hereford	Angus scale	7.4	26.8	45.1	11.8	-1.7
DS Pollfleck 809	Simm EPDs	0.4	19.8	32.0	10.4	0.5
Simmental	Angus scale	12.3	75.5	123.2	66.3	28.5
Polled Pack Leader 1182	Lim EPDs	6.9	25.0	51.0	19.0	6.0
Limousin	Angus scale	15.2	60.5	86.0	31.4	0.6
Polled Summit 648U	Gelbvieh EPDs	1.6	8.0	12.0	3.0	-1.0
Gelbvieh	Angus scale	12.2	55.2	64.4	52.6	25.0

a Across-breed EPDs on an Angus scale.

records of crossbred progeny in their databases that may eventually be used to increase the accuracy of AB-EPD calculations. Several breed associations are also considering and/or conducting multiple-breed evaluations.

The analytical method accounts for differences in EPDs of sires sampled at MARC and current breed average EPDs. Additional data are required on traits not already analyzed because AB-EPDs can be calculated only for traits for which within-breed EPDs are calculated. Traits evaluated by breed associations, other than the five traits included in the MARC analyses, vary considerably. Continuing education in the use of both within- and across-breed EPDs is necessary to assure understanding, acceptance, and proper use of both types of EPDs.

AB-EPD analyses are updated annually by: 1) including the current year progeny records; and 2) adjusting to a common genetic base. Updated tables of adjustment factors will be published in Beef Improvement Federation proceedings each year and also should be available from state beef cattle extension specialists in each state. Finally, the question of how to calculate accuracy values for AB-EPDs is being studied, although current results suggest that the within-breed accuracies are a practical approximation.

Conclusion

EPDs have not yet been developed for many economically important traits. Even with AB-EPDs, producers must know each breed's characteristics for all traits in order to make appropriate choices for crossbreeding systems. AB-EPDs are thus just one additional tool to help commercial producers to make genetic selection and crossbreeding decisions in order to attain their breeding objectives in a designed breeding system.

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