

Rick Bourdon, a Red Angus breeder currently involved in teaching and research at CSU, has designed this series (continued from last month's Journal) to help breeders understand and use available performance information.

A Series Beef Cattle Breeding

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Part Six Sire Evaluation I: Terminology—EBVs, EPDs, ACCs and PCs

Sire evaluation is a method of characterizing the breeding values of bulls based on progeny information from specific test herds or from a number of herds within a breed. The purpose of sire evaluation is to provide comparison of bulls from different breeding programs. Using sire evaluation data, we can identify those sires having the greatest genetic potential for the traits that interest us, and by using these bulls artificially, make genetic progress at a far faster rate than would be possible with strictly within-herd selection.

Sire evaluation is relatively new to beef cattle. It is well established in dairy cattle, however, and is the backbone (along with A.I.) of dairy cattle improvement. The tremendous increase in milk production of dairy cattle in the past 20 years can largely be attributed to the extensive use of bulls which were identified by sire evaluation programs as having extremely high breeding values for milk.

In beef cattle, there are two general types of sire evaluations: **designed tests** and **field data** evaluations. De-

signed tests are tightly controlled by breed associations or other organizations. These organizations specify the number of matings to be made in a test herd, the cows to which each bull is to be mated, and the methods for collecting records. Designed tests enjoy a high degree of credibility because the people collecting the test information usually have no vested interest in the bulls being tested and are, in any case, constrained by the rules of the sponsoring organization to do a fair job. Designed tests have the drawback of being expensive. Bull owners pay to

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have their bulls evaluated, and the costs involved tend to limit the number of sires and the number of test matings per sire.

Field data evaluations are relatively uncontrolled. The information used to evaluate sires is the same information that is routinely reported by breeders to breed associations. Breeders are free to make whatever matings they like and must comply only with their breeds' general rules for data collection. While field data evaluations appear to offer opportunities for unfair comparisons, they have the advantage of using large quantities of data that are already on file and constantly being updated.

Designed tests still exist, but the recent trend in sire evaluation has been toward the use of field data. For this reason, the three articles to follow this one will deal with field data sire evaluation.

The traits most commonly measured in sire evaluation are growth traits: birth weight, weaning weight and yearling weight. Some breed associations report information on calving ease of a bull's calves, calving ease of a bull's daughters' calves, and maternal ability. Designed tests often include carcass information. Traits like fertility, survivability and range hardiness, important as



they are, will not be included in sire evaluation programs until we have discovered appropriate ways to measure them and report the data.

Familiar terms

To understand and apply sire evaluation results, it is necessary to know the meaning of the acronyms and abbreviations that are the alphabet soup of sire evaluation jargon—namely EBVs, EPDs, ACCs and PCs.

EBVs in sire evaluation are conceptually the same as the EBVs or **Estimated Breeding Values** discussed in

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the last article. (No EBVs are included in the Angus Sire Evaluation Report, with the exception of Maternal Estimated Breeding Values which are taken directly off a current performance pedigree.)

EPD or Expected Progeny Difference is a term that presently has meaning only in a sire evaluation context. It is closely related to estimated breeding value. (The same data are used, but calculations are different.) An EPD differs from an EBV in that the EPD is the expected performance of a sire's progeny if he is mated to a random sample of cows as opposed to being mated to cows with breeding values like his own. The average breeding value of a random sample of cows should be very close to the population average. Therefore, if a sire is mated randomly, the average performance of his offspring should be the average of the sire's and dams' breeding values or halfway between his breeding value and the population average. For example, if a sire has a breeding value for birth weight of +4 lb., his progeny (assuming random mating) should average +2 lb. and his expected progeny difference is +2 lb. If a sire has a breeding value ratio for yearling weight of 108, his calves from randomly chosen dams should have average yearling weight ratios of 104, and the sire's EPD ratio is 104. Thus, a bull's EPD for a trait is half his breeding value for the trait.

As the above examples show, EPDs can be expressed either as deviations

or ratios. The current trend in the thinking of academic animal breeders is to follow the dairy example and express EPDs as deviations only. (In the Association's AHIR program and Angus Sire Evaluation, all EBVs are expressed as ratios and all EPDs appear as deviations, i.e. \pm lb.)

The nice feature of EPDs is that they are conceptually easy to understand. They are indeed *expected progeny differences*. If we use a bull with a weaning weight EPD of +30 lb., we expect his calves to be 30 lb. above breed average at weaning. Whether or not we actually see the 30 lb. will depend to some extent on the other sires we are using. This points out a second assumption of the EPD concept: not only must dams be chosen at random, the competing sires should be representative of sires in the general population.

Note: Beginning with the 1983 Angus Sire Evaluation Report, relative data as well as progeny data (i.e., the same data used to calculate EBVs) were used to calculate EPDs. In 1984, dam effect was considered to adjust for bias.

A potential problem with EPDs is the narrowness of their range. Cattlemen who are accustomed to individual performance records often find the relatively small amount of variability in estimated breeding values disturbing. EPDs are roughly half of EBVs, and so are less variable still. In practice, however, this is not such a problem. If bulls from across an entire breed are compared, they will usually be diverse enough to permit substantial differences in EPDs. (The 1984 Angus Sire Evaluation Report included bulls with a range in yearling weight EPDs of -42.7 lb. to +95.3 lb.)

Accuracy important

ACC stands for **Accuracy**. Every estimate, whether an EBV or an EPD, has an accuracy figure associated with it which tells us something about how much information was used in calculating the estimate and how reliable the estimate should be. We have already seen accuracy values in association with breeding value estimates. There they were defined as the correlation between the estimated breeding value and the true, unknown breeding value. Correlations approaching 1.0 represent very high degrees of accuracy while correlations of .5 or less indicate relatively meager information.

Another way of expressing accuracy which is commonly used with EPDs is the **Possible Change** value or **PC**. EPDs may be written as an estimate \pm

possible change. An example for weaning weight might be $+30 \pm 10$ lb. If we consider the EPD minus possible change to be a lower limit and the EPD plus possible change to be an upper limit, we create a range of values. (AHIR and Angus Sire Evaluation use only ACC values.)

Accuracy values emphasize the fact that EPDs can and usually will change over time as more and more information is collected. A bull's EPD in next year's sire summary will probably be a bit different and occasionally quite different than his EPD in this year's summary. It may take some time before enough information is accumulated on a sire so that his EPD remains relatively stable.

It is important to remember that such estimates of genetic value as EBVs and EPDs are *regressed for numbers*. In other words, they have already been adjusted to reflect the amount of information available. The adjustment process results in estimates that are the most likely to stand up over time. Therefore, it is perfectly legitimate to

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directly compare the EPDs of sires with widely differing numbers of progeny without further consideration of the accuracy of the estimates. The accuracy values really serve to inform us of the risks we are taking by using particular bulls. If you are a conservative type, you will probably opt for bulls with high accuracy values. If you are a little more daring, you could manage your risk by mixing the old stand-bys with bulls that are promising (favorable EPDs) but relatively untested (low accuracy). And if you are a real gambler and want extreme bulls, you might pick those with both high EPDs and low accuracy figures in hopes that their true progeny differences will be greater than their estimates. **AJ**

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NEXT:
Sire Evaluation II:
problems with field data
and sire evaluation.