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Utilizing EPDs as a Selection Tool in Beef Cattle

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Basics of EPDs

The first expected progeny differences (EPDs) for beef cattle were developed almost 35 years ago (Kriese-Anderson and Dolezal; 1999). While the predicted transmitting ability for the number and types of traits has increased, variable traits calculated from breed to breed, many would argue that EPDs are still the most accurate method to make selection decisions. Expected progeny differences allow beef producers the ability to more accurately select for and improve production traits that are important to their specific beef operation. As the number and types of EPDs have increased and as tools have been developed to increase EPD accuracy more rapidly, beef producers now have a valuable selection tool to more accurately improve their herds. Furthermore, the development of EPDs for a larger number of traits now allows producers the ability to apply multiple trait selection for a more complete and compatible animal in their specific production system.

When evaluating potential herd sires for a beef operation, an EPD will predict how that individual bull's purebred offspring will perform for a certain trait when compared to the base herd average for that specific breed. Although bulls are the predominant focus in EPD selection, due to the number of offspring they can have every year, it is still important to evaluate the genetic base (cow herd) to determine if the cow herd is genetically compatible to the bull in which they will be mated. While it is important to take into account the maternal compatibility, bull EPDs typically hold more weight because the accuracy of cow EPDs remains low due to the limited number of offspring they will produce in their lifetime when compared to the bull.

A basic example of evaluating bull EPDs would be evaluating bulls for birth weight in an effort to breed heifers. If bull A has an EPD of +4.6 for birth weight and bull B has an EPD of +1.0 for the same trait, which bull would be a safer sire to breed to heifers? In this example, Bull B's calves are predicted to be 1.0 pound heavier than the breed average and 3.6 pounds lighter at birth when compared to offspring of bull A. While this is a good example of basic selection, it is always suggested that multiple trait selection be practiced to select for many important traits in the production system, in order to produce a more complete animal and avoid detrimental related traits.

How Are EPDs Generated and What Are the Numbers?

EPDs are calculated using production data submitted to the breed associations by registered seedstock members. This information is input into statistical matrices to develop the estimated

breeding values of animals based on ancestral data, individual performance data, and progeny data as it becomes available.

It is important to remember that EPDs are not static and will change over time. The first thing that causes EPDs to change is when production data for that individual's offspring begins to be reported to the respective breed association. As more progeny data is incorporated, a bull's EPDs will change and become more accurate relative to their actual breeding value. The second way EPDs change is as the breed association updates the base herd average. This happens less frequently, but will cause increases or decreases in EPD values, even in the animals with the most accurate EPDs.

As the beef industry has utilized EPDs to select for traits such as increased marbling, higher weaning weight, or increased scrotal circumference, the average value for each trait within a breed has increased. This improvement in performance over time is known as a genetic trend. Genetic trend is the genetic change that occurs over time due to selection. This is another reason that the base herd average is adjusted, to more accurately reflect modern performance trends in the breed. Currently, many of the breed associations and the U.S. Meat Animal Research Center (US MARC) make it possible to see how offspring from a specific sire breed will perform for various traits (Table 1). This gives producers a more accurate perception of how a selected bull's predicted performance stacks up against other breeds and if a sire breed that they are interested in is compatible with their genetic base. The fact that every breed average is different, and base herd averages for the traits are different, are other reasons that utilizing as many tools as possible to evaluate a bull's genetic value is necessary to be even more accurate when making selection decisions.

Table 1. Adjustment factors for utilizing EPD's for crossbreeding (Kuehn and Thallman 2015).

Breed	Birth Wt. (lb)	Weaning Wt. (lb)	Yearling Wt. (lb)	Maternal Milk (lb)	Marbling Score[a]	Ribeye Area (in^2)	Fat Thickness (in)	Carcass Wt.(lb)
Angus	0.0	0.0	0.0	0.0	0.00	0.00	0.000	0.0
Hereford	1.6	-18.2	-42.1	-14.1	-0.29	-0.06	-0.075	-72.4
Red Angus	2.3	-28.3	-35.4	5.5	-0.13	0.06	-0.017	-16.6
Shorthorn	4.2	-39.8	-32.8	3.6	-0.13	0.60	-0.103	-18.3
South Devon	2.3	-32.5	-55.2	14.1	-0.47	0.66	-0.220	-67.2
Beefmaster	4.5	21.9	-0.3	9.9				
Brahman	10.6	49.5	15.8	19.4	-0.64	0.10	-0.169	-33.9
Brangus	3.3	13.9	4.5	12.3				
Santa Gertrudis	4.8	38.3	38.4	17.7	-0.46	0.04	-0.086	-8.8
Braunvieh	2.4	-24.0	-43.3	4.7	-0.58	1.11	-0.107	-48.9
Charolais	6.9	32.5	23.2	5.5	-0.26	1.21	-0.204	8.1
Chiangus	2.8	-19.3	-29.9	0.9	-0.16	0.57	-0.095	-18.5
Gelbvieh	2.8	-22.3	-32.1	6.5	-0.25	0.86	-0.103	-20.2
Limousin	1.7	-21.5	-46.9	-7.4	-0.22	1.13	-0.101	-21.6
Maine-Anjou	2.4	-33.3	-52.4	-7.0	-0.44	0.93	-0.184	-33.0
Salers	0.9	-16.5	-46.3	8.1	0.06	1.03	-0.179	-46.7
Simmental	2.9	-8.9	-14.9	3.8	-0.21	0.51	-0.105	-2.9
Tarentaise	3.4	18.5	-11.6	20.8				

[a]Marbling score units: 4.00 = Sl^{00}; 5.00 = Sm^{00}

EPDs and Crossbreeding

If a commercial producer is purchasing bulls of more than one breed, or using a bull of a different breed than their cow base in a crossbreeding program, there is a table of adjustment factors that makes it possible to compare EPDs across breeds (Table 2). However, it is important to note that these crossbred EPDs are just a simple guide and were calculated based off of US MARC EPDs that were being utilized on their facility. The EPD adjustment across all breeds, with all animals considered would be very difficult to calculate and would be highly variable. Many breeds provide actual breed averages for each trait (Table 1). In a crossbreeding system it may be more valuable to evaluate the breed averages (i.e., average birth weight, weaning weight, etc.), and then make a decision about what level of EPDs would be compatible with your genetic base (cows) and breeding needs from those breed averages. However, US MARC has calculated crossbreed adjustment values as another tool to increase producer accuracy when utilizing EPDs in crossbreeding schemes. Table 3 illustrates how to use breed averages and predicted EPDs to make selection decisions.

Table 2. Breed Averages from sires born from respective breeds. (Kuehn and Thallman 2015)

Breed	Birth Wt. (lb)	Weaning Wt. (lb)	Yearling Wt. (lb)	Maternal Milk (lb)	Marbling Score[a]	Ribeye Area (in^2)	Fat Thickness (in)	Carcass Wt.(lb)
Angus	86.1	567.2	1061.4	553.9	5.66	13.65	0.657	931.4
Hereford	89.6	548.5	1011.1	539.1	4.90	13.43	0.577	885.0
Red Angus	85.7	546.3	1025.5	557.3	5.40	13.36	0.623	899.8
Shorthorn	91.0	528.6	1000.5	551.6	5.04	13.77	0.500	886.1
South Devon	89.2	529.7	1001.2	570.1	5.04	14.05	0.437	858.2
Beefmaster	89.7	562.1	1014.1	549.8				
Brahman	97.2	583.7	1016.1	555.7	4.48	13.27	0.477	864.5
Brangus	89.0	556.9	1027.0	552.1				
Santa Gertrudis	89.7	559.7	1018.0	549.4	4.64	13.24	0.562	891.7
Braunvieh	89.7	537.3	998.1	570.3	5.13	14.62	0.451	870.1
Charolais	92.0	576.5	1045.8	545.3	4.90	14.70	0.448	921.3
Chiangus	89.8	539.9	1004.2	547.2	5.02	14.09	0.501	887.7
Gelbvieh	88.0	559.9	1036.3	562.9	4.93	14.45	0.496	902.9
Limousin	88.5	556.8	1011.3	549.8	4.65	14.77	0.476	897.7
Maine-Anjou	88.8	528.7	978.9	542.4	4.68	14.40	0.414	870.0
Salers	87.2	544.5	1010.5	558.8	5.33	14.23	0.468	872.6
Simmental	89.6	570.4	1049.5	555.7	5.04	14.47	0.482	920.5
Tarentaise	88.7	550.3	988.7	552.0				

[a]Marbling score units: 4.00 = Sl^{00}; 5.00 = Sm^{00}

Table 3. Example of using both published breed averages and individual EPDs to make selection decisions related to birth weight.

Bull ID	Breed	Breed BW Average	Individual EPD	Expected BW
1	Angus	86.1 lbs	1.5	87.6 lbs
2	Angus	86.1 lbs	5.8	91.9 lbs

Accuracies

Accuracy is a significant factor, when evaluating EPDs. This is usually listed in the parentheses next to the numeric EPD of an animal. The accuracy figure is defined as the relationship between the estimated EPD and the "true" breeding value of the animal in question. It is measured on a scale from 0 to 1, with a higher number indicating a more accurate EPD. Accuracy is a function of the amount of information available for that particular animal. The most common situation is that most beef producers purchase herd bulls as yearlings. This means they have no actual progeny data. As such, their EPDs are totally a prediction calculated using their individual performance and ancestral data from their sire and dam families. This also means the accuracy of a young bull's EPDs will be very low and producers may see variability from what is currently being reported. Even though a young bull's EPDs may have a low accuracy, it is still the most effective selection tool that cattle producers have available.

EPD values will change over time, as will their accuracy. However, in the past it has always been relative to time and data collection of progeny. As more progeny were generated and their production information incorporated into a bull's EPD calculation, EPDs became more accurate. With the advent of molecularly enhanced EPDs, less offspring are needed to increase the accuracy. This is because genomic (DNA) markers have been found to be associated with the trait the EPD is predicting are now being utilized to calculate the EPD. Thus, actual identified genomic material is being used in conjunction with the predicted value.

Summary

1. EPDs are presented in the units of the trait (Birth weight = lbs, Scrotal circumference = cm, Rib eye area = sq. inches, etc.).
2. EPDs are breed specific and more information is needed when using them in crossbreeding systems.
3. EPDs will change over time due to more data from progeny being entered into the system and adjustment of the breed base herd average.
4. Accuracies will change over time due to more progeny being produced and having their production data linked to the bull that sired them.
5. Although EPDs are a great tool for beef producers to utilize for selection, they must be used properly to generate genetic and performance progress in a herd. Producers should select EPDs at a level that is compatible with their genetic base (cows) in order to make sustainable progress.
6. Multiple trait selection should be implemented when utilizing EPDs in order to make sustainable improvement in a herd. Selecting EPDs at compatible levels for all the traits that will yield an optimal animal in a specific production system is essential for sustained improvement over multiple generations.

References

1. L. Kriese-Anderson, and S. Dolezal. 1999. ABC's of EPD's. Beef Magazine. March 1999.
2. L. Kuehn, and M. Thallman. 2015. Across breed EPD comparison table. United States Meat Animal Research publication.