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Using Expected Progeny Differences

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One of the most important decisions a cattle operator makes is selecting breeding animals to go into the cattle herd. Basing that decision on the genetic merit of the animal, not just the outward appearance, is critical to the herd's long-term performance.

Before Buying

A producer should consider several factors before buying a herd bull. The first step is to decide how the calves produced by the bull will be used, including when and how they will be marketed and whether replacement heifers will be retained. A producer who plans to keep replacement heifers should critically assess the operation's nutrition program to determine the herd's appropriate production level.

The second step is to match the operation's nutritional program to the herd's genetic potential. Otherwise, the breeding program won't succeed. For example, if cattle with high genetic potential for growth and milk are managed with limited nutritional resources, the reproduction rate may be reduced. Conversely, if under-productive cattle are placed on a high nutritional plane, the cattle will be inefficient, which will reduce profits. Commercial cattle producers should consider developing a crossbreeding program and then deciding what breeds to use. Different breeds have different production levels, and the breeds should be matched with the nutritional resources of the beef cattle operation.

The third step is to select the right bull. Four criteria should be met: reproductive soundness, structural soundness, performance, and visual appraisal. This publication will focus on the proper way to select for performance.

Evaluating Performance

When buying bulls, most producers are provided with information including actual measurements, contemporary group ratios, and Expected Progeny Differences (EPDs). The following is an assessment of these tools and their value in the selection process:

Actual Measurements—The actual measurement of an animal is controlled by factors including management, environment, and genetics. Measurements are not very useful when trying to determine how good a bull's calves will be, because they are much influenced by environment. A bull may appear to be good or bad because of the environment in which he was raised and not because of the genetics that he will pass on to his offspring. Advantageous management often masks poor genetics.

Contemporary Group Ratios—These ratios are calculated by dividing the average measurement of all bulls raised together under similar conditions into each bull's actual measurement, then multiplying by 100. The average bull in the group will have a ratio of 100. A ratio of 114 means the bull was heavier/larger than the average of the group by 14%. A contemporary group ratio is a good indicator of how the bull will perform compared to the group with which he was raised, but it provides no information on the merit of the group as a whole. Consequently, it is not a very good predictor of how a bull's calves will perform. Half the bulls in the worst herd in the country will ratio over 100.

Expected Progeny Differences (EPD)—EPDs are indicators of the genetic worth of an individual animal as a parent when compared to another individual of the same breed. EPDs are always reported in the unit of measurement for a particular trait (for example: weaning weight in pounds, scrotal circumference in centimeters, marbling in degrees). EPDs are computed based on any information available on the individual and its relatives. They are adjusted to allow comparison of animals born in different years and under entirely different environmental conditions. As a result, EPDs provide much more information for comparing animals than actual measurement or contemporary group ratio. EPDs are the single best piece of information available to determine the future performance of a bull's offspring. They should be the tool of choice.

Note: Nomenclature for EPDs used throughout this publication is general rather than breed-specific unless a specific breed is being referred to.

What EPDs Can Do

- EPDs allow the producer to compare two animals of the same breed in terms of their genetic merit for a particular trait. The animals' EPD differences indicate the differences expected in their progeny due to genetics (see Example 1).
- EPDs used along with the breed's EPD percentile table enable the producer to determine where the bull ranks within the breed for traits of economic importance. This ranking will provide the bull's relative production level within the breed (see Example 2).
- EPDs can be used to increase, decrease, or maintain any trait for which the EPDs are computed. Remember that maximums or minimums will not always be the right choice when making selections.
- EPDs can be used as one of several selection criteria. Producers should first decide which breed will most benefit their operation, then choose animals within that breed that are physically and reproductively sound. EPDs should be used in the selection decision for the traits for which they are computed. If EPDs are not available for important traits, actual measurements and visual appraisal are the best alternatives.

What EPDs Cannot Do

- In most cases, EPDs currently cannot be used to compare animals of different breeds.
- EPDs cannot predict outcome. A 40-lb weaning weight (WW) EPD does not mean that an additional 40 lb will be added to the weaning weight of the calves.
- EPDs do not provide a ready scale for overall ranking of the animal within the breed. EPDs are not averaged to zero. In other words, a zero EPD is not necessarily breed average. Each breed association sets its base year; the breed average for that year is a zero EPD. To illustrate, Herefords use 1975 as the base year, so a bull born today with a zero-pound birth weight (BW) EPD has the same genetic potential for birth weight as the average Hereford bull in 1975.
- EPDs are not constant. As more information is obtained on an animal, the EPDs may change, particularly as progeny information is recorded. This does not mean that the bull's genetic makeup changes as he ages, but that the ability to predict the bull's EPDs is improved as more information becomes available. It is impossible to predict whether an animal's EPDs will go up or down with additional information.
- EPDs do not make up for poor management. If exposed to a more favorable environment (better nutrition program, being bred to heavier milking cows, etc.), calves sired by a bull with a lower WW EPD can weigh heavier at weaning than calves sired by a bull with a higher WW EPD. If your neighbor's calves are heavier than yours despite your bull's higher EPDs, it does not mean your bull's EPDs are wrong. The neighbor's calves may be receiving more nutrition.
- EPDs are not a perfect science, so they don't always accurately reflect an animal's genetic potential. They should always be used as a risk management tool. For example, producers who are buying a bull to breed to heifers but won't be available to assist if calving problems arise should select a bull with a high-calving-ease EPD. Producers who are breeding to mature cows or who will be able to assist the cows when they're calving could use a bull with lower calving-ease values. To reduce risk, bulls with higher accuracy values can be used, but in those cases artificial insemination is often necessary. Young, unproven sires, most commonly used in commercial operations, will have low accuracy values and thus more risk. See the section on "Accuracy Values for EPDs," below.

Traits for Which EPDs Are Calculated

Each breed has a set of traits for which EPDs are calculated. Most breeds calculate EPDs for calving ease/birth weight, weaning weight direct, weaning weight maternal (also called maternal milk or weaning weight milk), and yearling weight. Some breeds calculate EPDs for other traits such as mature weight, scrotal circumference, and carcass characteristics. Development of EPDs for additional traits is continuing. Following is an explanation of currently calculated traits:

Calving Ease Direct (CED)

CED measures the calving-ease potential of a bull as a sire in percent of unassisted births when bred to heifers. A difference of 7 for calving ease would indicate the bull with the higher value would have 7% more unassisted births when bred to heifers. Birth Weight (BW) EPD is closely correlated to CED; however, it is important to remember that higher CED EPDs means more calving ease, while lower BW EPDs indicate more calving ease. If a CED EPD is available, use it instead of the BW EPD. If a CED EPD is not available, BW EPD can be used as an indicator trait for calving ease. Selection for calving ease is extremely important, particularly when selecting a bull to breed to replacement heifers. As cows mature, their ability to have larger calves without complication increases, and restrictions on CED or BW EPDs may be relaxed to some degree.

Implications—Birth weight and calving ease are highly correlated; as birth weight goes up, calving ease tends to go down. When computing EPDs, however, this relationship is taken into consideration. Calving ease and birth weight are also genetically correlated with cattle growth. When calving ease increases, birth weights tend to decrease, and weaning and yearling weights generally decrease too. Therefore, it is not advisable to simply buy the bull with the high CED EPD (particularly true when breeding cows that are not first-calf heifers) and ignore other economically important traits. Instead, within the desired breed, the producer should find a CED EPD that he or she is comfortable with and not buy a bull below this level. The BW EPD should be used only if the CED EPD is not available.

Calving Ease Maternal (CEM)

CEM indicates the genetic ability for calving ease of a bull's daughters. Higher values for CEM means the bull's daughters will be easier calvers. This is not an indication of the bull's own calving ease, which is indicated by the CED EPD.

Weaning Weight Direct (WW)

WW measures the genetic contribution of the parent to weaning weight with milking ability accounted for. In other words, it indicates the genetic potential of the calf to grow to 205 days. A difference in bulls' WW EPD is the expected difference, in pounds, of the average weight of their calves at 205 days of age.

Implications—Weaning weight direct is genetically correlated with calving ease, post-weaning growth, and milking ability. As weaning weight direct goes up, birth weight usually goes up (which can lead to increased calving difficulty), and milking ability usually goes down. Yearling weight usually increases, however.

Weaning Weight Maternal (MILK)

MILK measures the expected maternal contribution of a parent's daughters in pounds of weaned calf, primarily due to differences in milking ability. This EPD should not be confused with Total Maternal, which is a combination of WW and MILK. Bulls with higher MILK EPDs would sire daughters with an advantage in milking ability, and those daughters would be expected to wean heavier calves. Differences in two bulls' MILK EPD would be the expected difference in the average weaning weight of their daughters' calves, assuming no differences in growth genetics.

Implications—Milking ability is genetically correlated with growth traits.

As milking ability goes up, the genetic potential for growth often goes down. It also is extremely important to remember that increased milking ability in cows increases their nutrient requirements. If heavy milking cows are placed in a limited nutrition environment, a reduction in body condition score and subsequent reduced reproduction are to be expected.

Yearling Weight (YW)

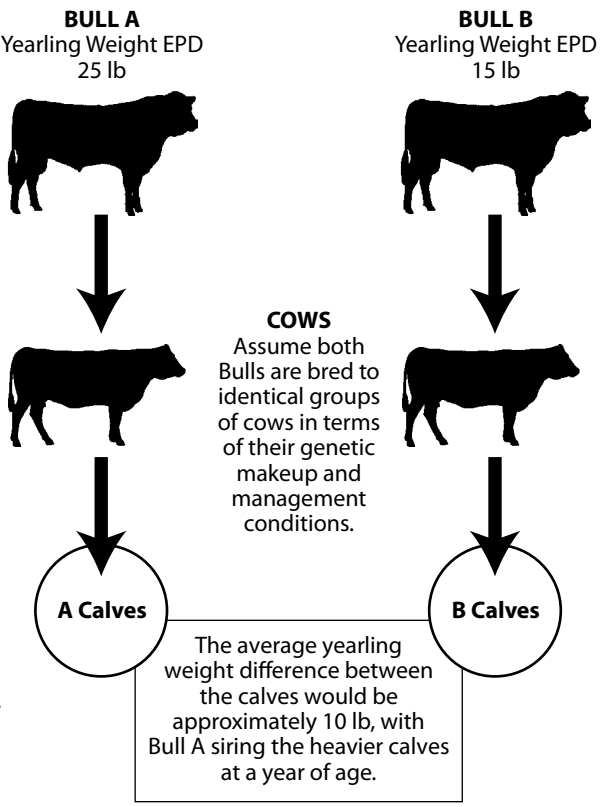
YW measures genetic differences in weight at 365 days. This EPD becomes more important than the WW EPD when the marketing endpoint is post-weaning.

Implications—Yearling weight is unfavorably correlated with calving ease and milking ability. Yearling weight is also highly correlated with mature weight. The mature size of the cow herd will increase if selection is made for increased yearling weight and replacement heifers are retained. Increased mature size, like increased milking ability, demands increased nutrient requirements.

How to Use EPDs

Example 1

Assume Bull A has a YW EPD of +25 lb and Bull B has a YW EPD of +15 lb. If these bulls were bred to an identical set of cows (in terms of genetics and environment), you would expect a difference of 10 lb in the average YW of their calves. Therefore, Bull A's calves would weigh 10 more pounds at 365 days than calves sired by Bull B.



Accuracy Values

As mentioned earlier, EPDs are never perfect. As more information is obtained on an animal, the EPD value may go up or down. Accuracy values indicate how much the EPD may change with new information. Remember that EPDs, regardless of their accuracy values, are still the best available estimate of an animal's genetic merit.

Accuracy values range from .00 to 1.00 and can be classified into the following basic categories:

low:	.00-.50
moderate:	.51-.70
high:	.71-1.00

As accuracy increases, the amount of possible change in an EPD as a result of added information becomes smaller. These ranges of possible change are both trait- and breed-specific. For an accurate range of possible EPD changes, a sire summary for the breed of interest should be obtained.

Unless artificial insemination is used, accuracy values are usually of little concern to commercial producers. Young bulls (which always have low accuracy) are usually purchased, and any offspring produced are crossbred calves or are calves that can't be registered. Therefore, the bull's accuracy will likely always remain low. Low-accuracy bulls are a fact of life for most commercial producers, but the bulls' EPDs are still the best available indicator of their progenys' performance.

Implications of Selection Based on EPDs

It is very important to know what the production goals are before trying to make selection decisions. Often, too much effort is spent trying to find the complete beef animal—one that combines growth, maternal ability, easy calving, reproductive efficiency, and high carcass quality and yield. Because several economically important traits are unfavorably correlated, it is virtually

Table 1. Selection based on EPDs.

EPDs	Response to Selection						
	Birth Wt	Weaning Wt	Yearling Wt	Milking Ability	Calving Ease	Mature Size	Replacement Maintenance
CED	–	–	–	0	+	–	0
WW	+	+	+	–	–	+	+
YW	+	+	+	–	–	+	+
MILK	0	–*	–*	+	0	0	+

+ As EPD goes up, this trait tends to increase.
– As EPD goes up, this trait tends to decrease.
0 No relationship.
* Selection for increased MILK EPDs tends to decrease the growth rate of the calves born; however, replacement heifers kept from these calves should have greater milk production and thus increase weaning and yearling weights in their calves.

How to Use EPD Percentile Tables

Example 2

Most of the major breed associations publish an EPD percentile table. These tables help producers establish where a bull ranks within a breed for each of the traits of interest. Some breeds even produce multiple tables—current (active) sires, current (active) dams, non-progeny sires, etc. For most producers a comparison against the active sires would be appropriate. For example, assume we're interested in a Charolais bull with a calving ease EPD (CE) of 5.5, weaning weight EPD (WWT) of 38, milk EPD (MLK) of 6, and yearling weight EPD (YWT) of 62. Using the table from the American-International Charolais Association shown here, we can determine that this bull is in the top 30% of the breed for calving ease, the top 10% for weaning weight growth, the top 55% for milking ability, and the top 15% for yearling weight growth. Now we can anticipate that this bull is going to be relatively easy calving, high growth, and produce daughters with about average (for Charolais) milking ability.

2010 CHAROLAIS NATIONAL CATTLE EVALUATION
AMERICAN-INTERNATIONAL CHAROLAIS ASSOCIATION

EPD Percentile Ranking for Active Sires

Top %	BWT	WWT	YWT	MAT	TOT MAT	SC	CE	MCE	HCW	REA	FAT	MARB
1	-5.8	48.1	84.6	22.0	37.9	1.6	14.5	12.2	36.5	0.74	-0.040	0.328
2	-4.8	46.1	80.8	20.4	36.3	1.4	12.8	10.9	32.4	0.65	-0.035	0.27
3	-4.2	43.8	77.4	18.8	34.9	1.3	11.7	10.3	30.7	0.58	-0.032	0.24
4	-3.7	42.6	74.8	18.2	33.8	1.3	11.0	9.8	29.5	0.54	-0.030	0.23
5	-3.2	41.7	73.2	17.6	33.0	1.2	10.5	9.4	28.4	0.51	-0.027	0.21
6	-3.0	40.8	71.3	16.8	32.0	1.2	10.2	9.1	27.5	0.49	-0.026	0.20
7	-2.7	39.8	70.1	16.3	31.4	1.2	9.9	8.9	26.7	0.47	-0.025	0.19
8	-2.4	39.1	68.7	16.0	30.8	1.1	9.5	8.6	26.0	0.45	-0.023	0.18
9	-2.3	38.5	67.9	15.6	30.3	1.1	9.3	8.4	25.0	0.44	-0.022	0.17
10	-2.1	38.1	67.0	15.2	29.9	1.1	9.1	8.2	24.3	0.42	-0.021	0.16
15	-1.4	35.7	62.1	13.6	27.9	1.0	7.9	7.5	21.8	0.36	-0.017	0.13
20	-1.0	33.6	58.7	12.3	26.5	0.9	7.0	6.9	19.7	0.32	-0.015	0.11
25	-0.6	31.9	55.6	11.1	25.2	0.8	6.2	6.3	18.1	0.28	-0.012	0.08
30	-0.2	30.3	52.7	10.1	23.7	0.8	5.5	5.8	16.8	0.25	-0.010	0.06
35	0.0	28.8	50.2	9.3	22.5	0.7	4.9	5.4	15.5	0.22	-0.008	0.05
40	0.3	27.5	48.0	8.5	21.3	0.7	4.2	4.8	14.3	0.19	-0.006	0.04
45	0.6	26.3	45.9	7.7	20.3	0.6	3.6	4.4	13.2	0.17	-0.004	0.02
50	0.8	25.1	43.6	6.8	19.3	0.6	3.0	3.9	12.1	0.14	-0.002	0.01
55	1.0	23.7	41.3	6.0	18.2	0.5	2.3	3.4	10.8	0.12	0.000	0.00
60	1.3	22.4	38.9	5.0	17.0	0.5	1.7	3.0	9.5	0.09	0.002	-0.01
65	1.5	21.1	36.9	4.1	15.9	0.4	0.9	2.5	8.2	0.06	0.004	-0.03
70	1.8	19.7	34.6	3.1	14.7	0.4	0.1	1.9	7.1	0.04	0.006	-0.04
75	2.1	18.4	32.1	2.1	13.5	0.3	-0.7	1.4	5.7	0.01	0.009	-0.06
80	2.4	16.8	29.0	0.9	12.0	0.3	-1.7	0.5	4.2	-0.03	0.012	-0.08
85	2.8	14.4	26.0	-0.4	10.3	0.2	-2.7	-0.4	2.1	-0.07	0.015	-0.10
90	3.2	11.4	20.8	-2.0	7.7	0.1	-4.3	-1.8	-0.5	-0.12	0.019	-0.13
95	4.1	6.9	12.6	-4.4	4.2	-0.1	-6.9	-4.1	-4.2	-0.18	0.026	-0.18
100	9.2	-24.8	-29.8	-19.3	-9.2	-0.8	-20.1	-20.3	-25.0	-0.70	0.080	-0.48

impossible to find this package. It may be more advantageous to focus on making improvements in a key area without losing ground on other economically important traits.

Purebred producers whose primary objective is to provide seed stock for commercial producers have several options available, depending on their customers' demands. One option is to provide bulls that are reasonably balanced for several traits (typically not excelling in any trait); another is to provide bulls that fit specific purposes (easy calving, high growth, etc.). Either way, EPDs can help. See Table 1 as a guide.

For example, if a genetically balanced animal is desired, the producer can mate cows with low calving ease, high weaning and yearling weight, and low milk EPDs to a bull with high calving ease, lower weaning and yearling weight, and high milk EPDs. Or, if the producer wants bulls to fit a specific purpose, bulls and cows with desirable EPDs for that trait (such as high-calving-ease bulls to high-calving-ease cows) can be mated. The EPDs of offspring from a specific mating should be close to the average of the parents' EPDs for all traits.

Commercial producers should decide which breed of bull will best suit production goals and then use EPDs within that breed to compare bulls for the traits of interest. The commercial producer should use the breed that fits long-term needs. For example, if replacement heifers are a major emphasis, a maternal-type breed should be chosen; if weaned pounds are of primary concern, a high-growth breed should be chosen. Once decisions are made on type of breed, a selection can be fine-tuned using EPDs. For example, if heifers are being bred to calves as 2-year-olds, high calving ease EPD bulls may be desired; if keeping or selling replacement heifers, MILK EPDs become more important.

Genetic changes come slowly. If the wrong decisions are made, it will take a long time to correct them, so it is important not to take selection decisions lightly. When a breeding plan within the herd is being considered, it is important to have long-term goals in mind and make selections toward reaching those goals. Understanding and using EPDs can be an extremely valuable tool in this process.

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