OKLAHOMA COOPERATIVE EXTENSION SERVICE

Expected Progeny Difference
Part 1, Background on Breeding Value Estimation

John Evans
Associate Professor Animal Breeding

David S. Buchanan
Professor of Animal Science

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://www.osuextra.com

Throughout history, geneticists have studied methods for use in identifying superior individuals in beef cattle populations. Sire selection has tremendous value to the beef cow-calf operation. Choices of herd sires not only have an impact on the resulting calf crops, but these choices also affect the performance of the cow herd if daughters of the sires are kept as replacement heifers. Ideally, beef producers would like to select sires of desirable genetics for genetic improvement in economically important traits. Selection of desirable genetics to match with a cow herd is a challenging task. Fortunately, the concept of breeding value provides beef producers an avenue to make useful selection decisions. The background on breeding value estimation leads to a better understanding of the merit of Expected Progeny Differences (EPD).

Breeding value

Breeding value is defined as the value of an individual as a parent. Parents transfer a random sample of their genes to their offspring. Estimated breeding value gives an estimate of the transmitting ability of the parent.

Expected Progeny Difference

One-half the estimated breeding value is equal to the Expected Progeny Difference (EPD). The word difference implies a comparison. Thus, EPDs let us compare or rank the superiority of individual animals. EPDs provide a prediction of future progeny performance of one individual compared to another individual within a breed for a specific trait. The EPDs are reported in plus or minus values in the units of measurement for the trait. For example, birth, weaning and yearling weight EPDs are reported in pounds. The EPD values may be used to compare only those animals within a breed. For example, the EPD values for a Hereford bull may not be compared against the EPDs for an Angus or Limousin bull.

Genetic evaluation

The first beef cattle national sire summary was published in 1971 by a breed association. Up until the first summary, only within-herd comparisons of breeding value could be made for a given year, season, and contemporary group. The national sire summaries in the early '70s and subsequent summaries allowed cattle within a breed to be compared across herds, generations, and regions of the United States. These evaluations by individual breeds were National Sire Evaluations (NSE). However, the NSE concept had some problems.

(1) Bulls had to have progeny information in order to be included in the evaluation. This meant that only older bulls were published in the summaries.
(2) No adjustment was made for the mating of superior cows to the bulls represented in the evaluation. The purebred breeders saw this as a big problem.
(3) Progeny records were used in the evaluation, but the individual record on a bull was not included.
(4) Breeding values were calculated on sires in the evaluation, but no genetic values were computed for dams.

A mathematical model, called the Animal Model was developed in the mid-1980s to correct the problems associated with NSE. Use of the Animal Model required extensive calculations. To reduce the number of equations that needed to be solved in an evaluation, the Reduced Animal Model (RAM) was developed. This approach reduced the amount of computer memory necessary to run the genetic evaluation.

The theory behind RAM was developed much earlier, but the computer technology was needed to process large numbers of equations for many animals. With the advances in computers, major beef breed associations today conduct National Cattle Evaluations (NCE) rather than National Sire Evaluations (NSE), because of its superiority in genetically evaluating cattle within a breed. The beef industry had progressed into an era of computing EPDs for all animals within a breed; thus, the terminology of cattle evaluation rather than sire evaluation was adopted.

National Cattle Evaluations conducted using RAM procedures calculate a genetic value for an individual within a breed, whether that individual is a sire, dam, or non-parent animal. Any combination of pedigree, individual records and progeny information is included to derive breeding values for all animals in the evaluation. The breeding values are divided by two and reported as EPDs.

The animal model approach adjusts for the merit of mates. Specific matings of inferior or superior animals are considered. Maternal genetic values, or Milk EPDs, may be computed for the maternally influenced trait, weaning weight. As with the previous evaluation (NSE), EPDs from the NCE are comparable across herds. Environmental and management differences are accounted for so that comparisons can be made.

Also, any genetic change within a breed for a particular trait is accounted for in the evaluation; therefore, comparisons may be made across generations of cattle. Young bulls with no progeny may be directly compared with older sires that have progeny.

Each EPD value should have an accuracy assigned to it. Accuracy is the measure of reliability associated with an EPD. It is expressed as a value between 0 and 1. A high accuracy (>.7) means a higher degree of confidence may be placed on the EPD and the EPD value is not expected to change much as further information is gathered. A low accuracy (<.4) means that the EPD may change a great deal as additional information is gathered.

Contemporary group

In the collection of beef cattle performance information, breed associations realize that contemporary group definition is critical. A contemporary group is a group in which animals of a given sex and age, having similar treatment, are given the equal opportunity to perform (Beef Improvement Federation Guidelines, 1990). The basis of sound performance testing relies on correct identification of contemporary groups. Accuracy in estimation of genetic differences within a group of animals is dependent on accuracy of grouping.

Summary

Breeding value estimation in beef cattle has an important history. Developments in animal breeding theory and computer technology have provided beef cattle producers with a selection tool for comparison or ranking of individual animals within a breed. This selection tool is an Expected Progeny Difference (EPD). National Cattle Evaluations conducted by individual beef breed associations combine pedigree, individual records and progeny performance to compute EPDs. The use of EPDs allows producers to make selection decisions for beef cattle traits of economic importance.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Samuel E. Curl, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0902

OKLAHOMA COOPERATIVE EXTENSION SERVICE

Expected Progeny Difference (EPD)
Part II, Growth Trait EPDs

John Evans
Assistant Professor Animal Breeding

David S. Buchanan
Professor of Animal Science

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://www.osuextra.com

Most beef breed associations express estimated breeding value as an Expected Progeny Difference (EPD). One-half the estimated breeding value is equal to the Expected Progeny Difference (EPD). The word difference implies a comparison. Thus, EPDs let us compare or rank the superiority of individual animals. EPDs provide a prediction of future progeny performance of one individual compared to another individual within a breed for a specific trait. The EPDs are reported in plus or minus values in the units of measurement for the trait. For example, birth, weaning and yearling weight EPDs are reported in pounds. The EPD values may be used to compare only those animals within a breed. In other words, the EPD values for a Hereford bull may not be compared against the EPDs for an Angus or Limousin bull. The EPD values are most useful when two individuals are being compared directly. For example, consider the two sires in Figure 1 and assume that both sires are from the same breed and that the EPDs have equal accuracies.

Figure 1. Example of Birth Weight EPD

	Sire A	Sire B
EPD in pounds	+5	-2

The Expected Difference in the Progeny of Sire A and Sire B for birth weight is 7 pounds. Sire A has an EPD of +5 and Sire B has an EPD of -2. On the average, we should expect the calves by Sire A to be 7 pounds heavier at birth than calves of Sire B, if all the calves are managed uniformly and are from cows of similar genetic merit. The predicted performance difference is 7 pounds although it is not possible to estimate the actual birth weight average for these calves. The EPDs allow the prediction of performance differences, not actual performance.

Each individual member of a breed can have EPD values calculated for it. Purebred breeders report data to the national herd improvement program for their breeds to contribute to the breed national database. Age and sex of a calf or status as a parent are not limiting factors. A newborn calf could be assigned EPDs. It is possible to compare any two members of the breed regardless of location but comparisons cannot be made across breeds. Each individual has its own performance and the performance of progeny, sibs, parents, grandparents, etc., that can be utilized to evaluate genetic merit. New animal breeding and computer technology result in techniques whereby the performance of the animal and information on its relatives is included in the estimate of genetic merit. Thus, EPDs are available on parent and nonparent animals. This process involves extensive calculations which only the latest generation of computers are able to accomplish efficiently.

The EPD values are available for all animals, male and female. Preferential mating of certain individuals does not bias the results. A genetically superior bull can be mated only to genetically superior cows and his EPD will not be inflated. This is accomplished by adjusting for the EPDs of the cows to which he is mated. Appropriate adjustments are made for genetic trend. For example, this adjustment allows young bulls to be directly comparable to older bulls with many progeny records.

Figure 2 is an example of weaning weight EPDs. It describes a weaning weight difference in the progeny of two bulls.

Figure 2. Example of Weaning Weight EPD

	Sire A	Sire B
EPD in pounds	+25	-10

The Expected Difference in the Progeny of Sire A and Sire B for weaning weight is 35 pounds. Sire A has an EPD of +25 and Sire B has an EPD of -10. On average, we should expect the calves by Sire A to be 35 pounds heavier at weaning than calves of Sire B, if all the calves are exposed to the same environmental conditions and are from cows with similar genetic merit.

Figure 3 is an example for yearling weight. It describes a yearling weight difference in the progeny of two bulls.

Figure 3. Example of Yearling Weight EPD

	Sire A	Sire B
EPD in pounds	+50	+10

The expected difference in the Progeny of Sire A and Sire B for yearling weight is 40 pounds. Sire A has an EPD of +50 and Sire B has an EPD of +10. On average we should expect the calves by Sire A to be 40 pounds heavier at one year of age than calves of Sire B, if all the calves are managed uniformly and are from cows with similar genetic merit.

Breed average EPD and Base Year. It is frequently said that an EPD is a comparison to an average bull. This is not an accurate statement. A zero EPD represents the average genetic merit of animals in the database at the time when there was sufficient information to calculate EPDs. Therefore, it represents a historic base point, or base year. Some breed associations now set the base year to a particular year. If the breed has made any genetic change for a trait, the average EPD for the trait will no longer be zero. Breed association publish the average EPDs in the sire summaries made available to the public. Information printed in the summaries should be examined carefully before individual EPDs are studied.

Accuracy is the measure of reliability associated with an EPD. Each EPD value should have an accuracy assigned to it. It is expressed as a value between 0 and 1. A high accuracy (>.7) means a higher degree of confidence may be placed on the EPD and the EPD value is not expected to change much as further information is gathered. A low accuracy (<.4) means that the EPD may change a great deal as additional information is gathered. Nonparent animals have lower accuracy values since no porgeny information contributes to their EPD. From a practical viewpoint, the EPDs are used to select bulls for use in the herd, and accuracies help determine how extensively to use the bulls in the herd. Some sale catalogs do not list accuracies with the EPDs. On young animals with no progeny data, such as yearling bulls, one would realize that accuracies would be low.

Possible Change is the measure of the potential error associated with EPD values. Many sire summaries are starting to include such values. Possible change is expressed as "+" or "-" pounds of EPD. These values quantify the amount a certain EPD may deviate from the "true" progeny difference. Accuracy and possible change values share a relationship. As more information is accumulated, accuracy increases and possible change diminished. For a given accuracy, the "true" progeny differences of two-thirds of all animals evaluated within a breed are expected to fall within the plus or minus possible change value. An example to illustrated this point follows:

Birth weight EPD = +2.0 pounds Accuracy = .60
Possible Change = + 1.3 pounds

Of all the animals with this EPD and Accuracy, two-thirds of the animals are expected to have "true" progeny differences between +.7 and +3.3. These "true" differences have a much greater chance of falling toward the center fo the range defined by the possible change value than falling close to the extremes.

Also, one-third of the individuals in the evaluation may have their "true" progeny difference values fall outside the range of +.7 and +3.3. This means that one-sixth of the individuals may have "true" values less than +.7, and one-sixth of the individuals may have "true" values more than +3.3.

Sire Summaries include a sampling of the available genetic material in each breed. The summaries for breeds that conduct National Cattle Evaluations come out at least once a year. Summaries include EPDs, accuracies, graphs of the average change in EPD for the particular breed, breed average EPDs, possible change values and other useful materials. Descriptive material written at the first of each summary describes the format for reporting the EPDs.

An example of a sire summary is listed below. The example presents EPDs and accuracy values (ACC) for traits commonly found in most summaries.

Sire	*Birth wt*		*Weaning wt*		*Milk*		*Yearling wt*	
	EPD	*ACC*	*EPD*	*ACC*	*EPD*	*ACC*	*EPD*	*ACC*
Bull 007	+4.0	.90	+24	.90	+12.0	.70	+50	.80
Bull 086	+2.0	.70	+12	.60	+5.0	.15	+35	.50

At least 16 beef breed associations currently conduct national cattle evaluation programs. Almost all sire summaries include birth weight, weaning weight, yearling weight and milk EPDs. A few currently include some characteristics that have a role in reproduction such as calving ease, gestation length and scrotal circumference. Many of the breeds are currently working to include some of these other characteristics into the summaries. There is a fairly large effort to incorporate more carcass information. Carcass evaluations may result in EPDs for carcass weight, rib-eye area, fat thickness and marbling score.

Many of the summaries contain two listings of bulls. The first is a listing of progeny proven bulls. These are older bulls that have calves with performance records; therefore, the accuracies on the birth and weaning weight EPDs are generally at least .5. The second section is devoted to younger bulls that have lower accuracies (.3 to .5 on weaning and birth weight). The criteria for listing varies among the breeds.

Summary

Expected Progeny Difference (EPD) values let beef producers compare or rank the superiority of individual animals within a breed. These EPDs are readily available to beef producers for use in sire selection, provided bulls compared are from the same breed. Many of the beef breed associations conduct national cattle evaluations and publish sire summaries at least once per year. Growth trait EPDs for birth, weaning and yearling weights are commonly available for most breeds of beef cattle.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Samuel E. Curl, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 1202

OSU

Expected Progeny Difference: Part III, Maternal Trait EPDs

John Evans
Associate Professor Animal Breeding

David S. Buchanan
Professor of Animal Science

Maternal effects are an important consideration when evaluating beef cattle performance. Extensive studies have been conducted to quantify maternal effects for a variety of traits, especially those measured during the preweaning period. Phenotype is the physical expression of the genetic makeup of an animal. In beef cattle, the dam makes at least two contributions to the offspring phenotypic value. These contributions are the sample half of her genes passed directly to the offspring and the maternal effect she provides her calf. A **maternal effect** is defined as any environmental influence that the dam contributes to the phenotype of her offspring. The contribution of the dam is environmental with respect to the calf (mothering ability, milk production, environment, maternal instinct). The genetics of the dam allow her to create this environment for her calf. Maternal effects are important during the nursing period with diminishing effects through post weaning.

Milk EPD. Weaning weight can be determined by the genes for growth in the calf and genes for milk (mothering ability) in the cow. There are separate EPD values for these two components. The Weaning Weight EPD evaluates genetic merit for growth and the Milk EPD evaluates genetic merit for mothering ability. The Milk EPD that results from the separation of weaning weight into growth and milk segments is, like any other EPD, fairly simple to use. It is the expected difference in weaning weight of calves from daughters of a particular sire, due to differences in mothering ability. As an example, consider two bulls in Figure 1.

Figure 1. Example of Milk EPD.

	Sire A	Sire B
EPD in pounds	+10	-5

The expected difference in the progeny from daughters of Sire A and Sire B is 15 pounds. Sire A has a Milk EPD of +10; Sire B has a Milk EPD of -5. The expected weaning weight difference, due to mothering ability alone, in calves from daughters by the two bulls is 15 pounds. The15 pounds are expressed in pounds of weaning weight, not pounds of milk.

Combined Maternal EPD (sometimes called maternal weaning weight or total maternal) reflects both the milking ability transmitted to daughters and direct weaning growth transmitted through daughters to their calves. An example is illustrated in Figure 2.

Figure 2. Combined Maternal EPD.

	Weaning Weight EPD	Milk EPD	Combined EPD
Bull A	+20	+12	+22
Bull B	+4	+6	+8

Combined (Bull A) = 1/2(20) + 12 = 22
Combined (Bull B) = 1/2(4) + 6 = 8

Bull A has a direct Weaning Weight EPD of +20 pounds. This expresses the ability of the bull to transmit weaning growth directly to his progeny. On average, calves sired by Bull A should be 16 pounds heavier at weaning than calves sired by Bull B, assuming both bulls are mated to a comparable set of females and the calves are exposed to the same environmental conditions. The 16-pound difference in future progeny performance is due to genes for direct weaning growth.

The Milk EPD for Bull A (+12) is the contribution to his daughter's calves solely through transmission of genes for mothering ability. The Expected Difference in the Progeny from daughters of Bull A and Bull B is 6 pounds. Bull A has a Milk EPD of +12; Bull B has a Milk EPD of +6. The expected weaning weight difference, due to mothering ability alone, in calves out of daughters by the two bulls is +6 pounds.

The Combined EPD for Bull A (+22) is computed by taking 1/2 the Weaning Weight EPD plus all the Milk EPD. The +22 pounds affect both the milking ability transmitted to daughters and the direct weaning growth transmitted through the daughters to their calves. In a similar method, the Combined EPD for Bull B is 1/2 times the Weaning Weight EPD plus the Milk EPD, or +8 pounds. An average difference of14 pounds would be expected as the difference in weaning weight of calves out of daughters of the bulls based upon the genetic merit for growth (WW EPD) and milk (Milk EPD).

Calving Ease EPDs

Calving ease heritabilities have been reported to be small (.00 to .13) for beef cattle. The magnitude of the estimates indicate that little genetic progress can be made on selecting directly for calving ease. However, there are exceptions where calving ease heritabilities have been reported to be

over .46 in particular studies. Some breed associations report calving ease EPDs along with birth weight EPDs while other associations' reports do not include calving ease EPDs. Breeds that report calving ease EPDs may present them in different formats. Be sure to study the meaning of calving ease EPDs separately for each breed. Descriptive material written at the beginning of most sire summaries should be useful in interpreting the meaning of calving ease EPDs. Different breeds may list the calving information in different formats. At this time, calving ease EPDs are available only for the Simmental and Gelbvieh breeds. The EPDs are presented differently by each breed.

For the Simmental breed, the calving ease EPDs are given in two ways: Calving Ease EPD and Maternal Calving Ease EPD. Calving ease EPDs are expressed as deviation of percent of unassisted births. When comparing the EPDs of two animals, a larger EPD represents a higher percent of unassisted births. Calving Ease EPDs may be given for heifers and for cows separately. For heifers, this is the ease with which calves of a sire are born to first-calf heifers. For cows, this is the ease with which calves of a sire are born to mature cows.

Maternal calving ease EPDs are the ease with which daughters of a sire calve as first-calf heifers. These may also be given as the ease with which daughters of a sire calve as mature cows. When comparing sires, the larger EPD represents a higher percent of unassisted births for calves born from daughters of a bull.

For the Gelbvieh breed, the Calving Ease Direct EPD is an EPD that is expressed as a ratio, with a higher ratio representing a better (easier) calving ease. This value represents the direct effect a sire has on calving ease. EPD values greater than 100 indicate above-average calving ease (fewer difficulties expected). Ratios below 100 indicate below-average calving ease (more difficulties expected).

For maternal in the Gelbvieh breed, the Calving Ease Daughters EPD is an EPD expressed as a ratio for a sire's daughters calving ease with a higher ratio being a more favorable calving ease. This EPD value represents the calving ease that a sire transmits to his future daughters.

The description of calving ease EPDs given for the Simmental and Gelbvieh breeds illustrate that each breed must be studied before using the EPDs as tools for selection. When available, calving ease EPDs can be used to add additional information to selection decisions.

Summary

Milk EPDs are widely available from beef cattle breeds. The values are expressed in pounds of weaning weight. Direct comparisons of Milk EPDs may be made between individuals within a breed. The Milk EPD is the expected difference in weaning weight of calves from daughters of a bull compared with calves from daughters of another bull, due to mothering ability. Beef producers may use Milk EPDs as part of their selection program when choosing bulls to sire replacement heifers for their herd. The Combined Maternal EPD is another value available for use in sire selection. It is the sum of one-half the Weaning Weight EPD plus all the Milk EPD. The Combined Maternal EPD reflects both the mothering ability transmitted to daughters and direct weaning growth transmitted through daughters to their calves.

Calving Ease EPDs are available for certain breeds. These values may be reported separately for heifers and for cows. Details about these values and their use should be studied before selection decisions are made.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Samuel E. Curl, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0902

OSU

Expected Progeny Difference: Part IV, Use of EPDs

John Evans
Associate Professor Animal Breeding

David S. Buchanan
Professor of Animal Science

Use of EPDs for selection in purebred herds

Purebred producers need to consider EPDs in their breeding programs. Competitors are using EPDs and making genetic change in their beef herds. However, care needs to be exercised when making selection decisions. Type fads have caused some problems in the past when single traits have been emphasized. Similar, or worse, problems may arise if a single performance trait is emphasized. For example, if the members of one breed association began to emphasize yearling weight, and ignored all other characteristics, several concerns might arise. Birth weight would be expected to increase, with the attendant calving difficulty. Mature size should also increase, perhaps to the point where the functionality of the cow herd would diminish. This could also lead to problems in reaching desirable quality grade at an acceptable weight. Each trait has a set of drawbacks if changes are carried to an extreme. The availability of EPDs would make such extremes easier to achieve if breeders chose to blindly emphasize a single trait.

A more balanced selection program is certainly desirable. Some producers recommend choosing herd sires that have a balanced yearling weight EPD, milk EPD and birth weight EPD. It also needs to be recognized that there are still many important traits that are not included in the sire summaries. Careful monitoring of reproductive performance, conception rates, calf mortality, regularity of calving, and libido in bulls is critically important. Carcass characteristics may have increased importance in the near future; therefore, breeders are encouraged to obtain whatever carcass data is feasible and use it in making some selection decisions. Carcass EPDs should be available in several breeds soon, but more complete databases need to be established.

Most beef breed associations have EPDs. Purebred breeders should obtain EPDs on each member of their herd if their association provides the service. Although the accuracies are sometimes low on these EPDs, they should be used when choosing replacements, and where possible, when culling cows.

Purebred producers are not only users of EPDs, but they also provide the data used in calculating EPDs. Producers are encouraged strongly to provide complete, accurate records on all calves born each year. Complete, accurate record keeping is the only way that useful EPDs can be calculated.

Use of EPDs for selection in commercial herds

Obviously, it will be the rare commercial producer that uses bulls that are listed in a breed association's sire summary. What then should the commercial producer do about EPDs? Many breed associations have a mechanism in place where individual purebred producers can obtain EPDs on each animal in their herd including the calves. Commercial producers should demand the information from their purebred breeding stock sources.

A commercial producer has a major responsibility of choosing the appropriate breed, or breeds, for his/her program. Once breeds are chosen, examination of what is needed in replacement breeding stock is in order. Some recommendations for commercial scenarios are shown in Table 1.

Each of these recommendations should be followed while at the same time considering the prevailing conditions. Rougher conditions probably dictate the need to avoid very high EPDs for growth or milk and even more to avoid high birth weights. Growth EPDs should be geared to the needs of the potential buyers. Also, traits for which there are no EPDs as yet can be important. Traits associated with reproduction certainly fall into this category. Commercial producers should demand that the seller's bulls should have passed a breeding soundness examination.

EPDs within a breed are directly comparable between herds. Therefore, if a commercial producer has more than one source of breeding stock, he/she can compare the genetic merit of the different sources. EPDs cannot be compared between breeds. A bull with a low birth weight EPD from a large mature size breed may sire calves that are heavier than a bull with a high birth weight EPD from a moderate sized breed. A low birth weight EPD does not guarantee a minimum of calving difficulty if the choice of breeds is incorrect.

Pedigree estimated EPDs

Many sale catalogs will contain Expected Progeny Differences (EPDs) for the bulls offered for sale. Some bulls will appear in catalogs with limited or no EPD information. This may be particularly true for young bulls that have not had their performance information included in the breed genetic evaluation yet. Bull buyers may use a quick and easy procedure to compute "Pedigree EPD" values for young bulls with no EPDs.

Pedigree EPDs may be computed provided that you have access to EPDs on the animals in the pedigree of the young bull. By using the EPDs on animals in the young bull's pedigree, you are ready to compute Pedigree EPDs.

Each calf receives a random sample half of the sire's genes and a random sample half of the dam's genes. The two halves combine to form the complete genetic makeup of the calf. Parents of the calf also receive their genetic makeup in the same way, with half of their genetic makeup contributed by each of their parents. By understanding this halving nature of inheritance, the EPDs on parents and grandparents in the pedigree of a young bull may be used to compute Pedigree EPDs.

Procedure to calculate Pedigree EPD

The first step in calculating the Pedigree EPD for a young bull is to determine how much EPD information is available on the animals in the pedigree of the bull. Most of the time, the breeder of the young bull will supply you with a performance pedigree including EPDs for the sire, maternal grandsire (MGS), maternal great grandsire (MGGS), and maybe even the dam of the young bull.

Next, calculate the Pedigree EPD on the young bull using the EPD information available to you. The following are some examples:

(1) If both sire and dam of the young bull have EPDs, take one-half the EPD of each parent.

Ped. EPD = $^1/_2$ EPD of Sire + $^1/_2$ EPD of Dam

(2) If the EPD on the dam is missing, you may use EPDs on her relatives.

Ped. EPD = $^1/_2$ EPD of Sire + $(^1/_2)^3$ EPD of MGS
= $^1/_2$ EPD of Sire + $^1/_4$ EPD of MGS

(3) Another option is to use the maternal great grandsire (MGGS) information, too.

Ped. EPD = $^1/_2$ EPD of Sire + $(^1/_2)^2$ EPD of MGS + $(^1/_2)^3$ of MGGS
= $^1/_2$ EPD of Sire + $^1/_4$ EPD of MGS + $^1/_8$ EPD of MGGS

NOTE: If the EPD of the Dam is known, then you cannot use the EPD information on the MGS and MGGS.

Knowing the procedure to compute Pedigree EPDs may be useful in selecting young bulls with no EPDs available. Some breed associations have an "Interim EPD" program based on pedigree information to provide EPDs on young animals that have not had an opportunity to have their individual performance included in the most recent national cattle evaluation for the breed. Many sale catalogs may already give you the Pedigree EPD for convenience.

Across-breed EPDs

Currently, all EPDs are used only on a within-breed basis. They are calculated for the specific breed; therefore, the EPDs are only useful for comparisons of future progeny performance for cattle within that breed. Although there is interest in developing across-breed EPD comparisons, the methodology for accomplishing this is in the development stage.

Summary

Commercial and purebred cow-calf producers have EPDs available to them as a powerful selection tool. The EPDs allow comparisons between individuals within a breed for performance traits. The purebred breeder may obtain EPDs on each member of their herd, by participating in cattle evaluation services available through their respective breed association. Commercial producers may use EPDs provided to them in sire summaries, bull sale catalogs, and other sources in order to make directional change in the genetics of the beef herd. Once the appropriate breed choices are made, the producer has the opportunity to use EPDs as a tool in sire selection. EPDs allow fair comparisons of future progeny performance for bulls of the same breed. Cow-calf producers have EPDs as an opportunity to add predictability to the genetics of their cattle.

Table 1. Recommendations for EPDs for Various Commercial Scenarios.

Use of Individual	*Breed*	*Birth*	*Weaning*	*Yearling*	*Milk*[a]
Terminal sire on mature cows	large carcass	not too high	high	high	not relevant
Bull to use with heifers	small to medium size	low	moderate	moderate	consider, if keeping heifers
Sire replacement heifers	medium size maternal	low to moderate	moderate to high	moderate to high	varies

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Samuel E. Curl, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0902