The Canadian Junior Hereford Association Presents:

Expected Progeny Differences

All living beings are the product of their genetics & their environment

tools of the trade

Introduction

Expected Progeny Differences (EPDs) are a tool to help select breeding animals based on their genetics. They estimate the genetic potential of the animal based on complicated mathematical equations. EPDs attempt to compensate for environment and management techniques to isolate genetic potential. Selecting the best EPDs for your type of cattle, environment and goals of your operation, combined with good management, will produce better cattle.

What Are Genes?

Genes are the part of the animal we can't see, even with a microscope. Genes are the pieces of information that tell an animal how to grow and produce, what colour it should be, or if it is horned or polled. These bits of information are passed down to the animal's progeny.

All genes are located on chromosomes within the cells of an animal. Cattle have 60 chromosomes in 30 pairs. Every calf receives 30 chromosomes from its mother and 30 chromosomes from its father.

The way an animal looks, and the parts of an animal we can measure is called a phenotype. The genes that produce this phenotype is called a genotype.

A certain characteristic of an animal, controlled by genes, is called a trait. Weaning weight is an example of a trait, as is colour or horn status. Some traits like colour or horned/polled/scurred are controlled by very few genes, while other traits are controlled by hundreds or even thousands of genes. For traits controlled by only a few genes, it is easy for us to predict the outcome of a particular breeding. However, it is much more difficult to predict an animal's performance in a certain trait that is controlled by many genes. EPDs help us predict those outcomes.

Most genes consist of two copies called alleles and one allele comes from the mother, while the other comes from the father. Often, one of the copies is dominant to the other copy, which means it will be expressed in the phenotype.

In cattle, black colour is dominant to red and polled is dominant to horned. That means a calf has to have 2 copies (alleles) of the recessive gene (red/horned) to be red or horned.

Predictions

Predicting how an animal will perform is tricky business. It requires a lot of information that must be measured and recorded accurately. If the data are falsely reported or measured poorly, the prediction will be poor.

As we can't see the genes that are controlling the traits we want to improve (weights, carcass, fertility, etc.), we have to measure them. That is why purebred breeders keep all those records. Recording and reporting calving ease, birth weight, weaning weight, yearling weight, mature weight, scrotal circumference, ultrasound, and breeding dates all improve our ability to accurately predict the performance of a certain animal's progeny.

Remember that all living organisms are a product of their phenotype and environment. This means that we cannot accurately predict genetic potential without accounting for environmental differences. **Management groups** help us do that. By placing animals that are managed the same in the same group, we are putting calves raised under the same conditions together for comparison. For example, all animals raised on the same pasture should have the same management group. An animal that was treated for sickness should have a different management group. **Contemporary groups** split the animals up even further, by age and sex. All of these groups make sure that we are comparing the same types of animals, and not trying to compare apples to oranges.

Heritability is the portion of the phenotype due to genetics. Remember that the phenotype includes both genetic and environmental effects, so if the heritability for a trait is 0.40, that means 40% of what we are seeing in the phenotype is due to genetics, while the other 60% is due to environment. Different traits have different heritabilities, and some genes affect more than one trait at the same time.

Correlations describe the relationship between genes. Positive correlations mean that as one increases, so does the other. For example, weaning weight and yearling weight are positively correlation, thus we can expect an animal with a higher weaning weight to also have a higher yearling weight. Negative correlations mean that as one increases, the other decreases. For example, as birth weight increases, calving ease generally decreases.

Expected Progeny Differences (EPDs)

Expected Progeny Differences (EPDs) are the best tool available for improving genetic merit within a herd. Unfortunately, this tool is often misunderstood and misused, causing confusion and distrust of the system.

An EPD is a prediction of the difference between the average performance of an animal's future progeny and the average progeny performance of another animal whose EPD is zero, assuming that bulls are mated to similar cows, or vice versa. It is important to remember that an EPD is **not** a prediction of individual performance. Information used in computing EPDs includes pedigree and performance of relatives, self, and progeny. An EPD does not correspond to any specific value for a particular trait. (i.e. a weaning weight EPD of 46.6 does not equal an actual weaning weight of 650 lbs for an animal's progeny). EPDs for different breeds cannot be compared to each other. The breed average EPDs are not zero - see the CHA website for current averages.

The method used to compute EPDs takes into account environmental & management differences among contemporary groups (animals of the same sex raised under the same management conditions), the genetic merit of cows a bull is bred to, an animal's own performance & that of their relatives, and genetic trend of the entire breed. It is often thought that EPDs are calculated in the same way as 205 day adjusted weights. This is not the case – to calculate EPDs on all recorded animals millions and millions of equations must be calculated simultaneously.

A bull with great EPDs does not guarantee a superior calf crop. A common producer beef with EPDs is that they do not seem to correspond to actual data. As EPDs rely on information provided by the producer, it is critical that the correct information be submitted (e.g. correctly identifying different management groups). In addition, billions of genetically different progeny are possible from just a single mating! This means that there is a lot of variation possible – and remember that EPDs are a prediction of the **average** progeny performance – so it is very possible to have a calf or two that don't fit in with the rest! This is where accuracy comes in.

Molecular EPDs use actual genotypes to predict genetic merit. Often these genotypes are combined with existing EPDs to create a value which increases accuracy at a much younger age - remember that genetics don't change. They are also used to predict genetic merit for traits that are hard or expensive to measure, such as feed efficiency. The benefit of molecular EPDs lies in the fact that they are not predicted from a measurement of a phenotype, but rather the genotype of the animal. Combining the genotypic information with the phenotypic & pedigree information provides a much more powerful tool.

Accuracy

Accuracy is a value between 0 and 1 that attempts to determine how close the prediction (EPD) is to the true breeding value. Accuracy values increase as the amount of information known on an animal increases (what is known about own performance, the performance of related animals, and progeny performance). The possible change tables in the Sire Summary and EPD Tools, Averages & Trends documents on the website provide a good guide as to how EPDs may change with differing accuracy levels. The higher the accuracy, the less likely an EPD is to change with the addition of new information. Accuracy represents how close the reported EPD is to the true genetic merit of the animal. PE stands for pedigree estimate, and is just the estimate of an EPD by adding 1/2 the EPD from the sire and 1/2 the EPD from the dam.

Accuracy	Interpretation
PE to <0.10	Very low accuracy. EPDs should be considered a preliminary estimate. They could change substantially as more performance information becomes available.
0.10 to 0.25	Low accuracy, usually based on the animal's own records and pedigree. Useful for screening "best bet" animals. Still subject to substantial changes with more information, particularly when the performance of progeny are analysed.
0.25 to 0.40	Medium accuracy and includes some progeny information. Becoming a more reliable indicator of the animal's value as a parent.
0.40 to 0.70	High accuracy. Some progeny information included. Unlikely that the EPD will change very much with the addition of more progeny data.
>0.70	Very high accuracy estimate of the animal's true breeding value.

Mission Statement

"Our mission is to be an open, enthusiastic and honest group dedicated to the improvement of ourselves, our group, and our industry. We exist to encourage, organize and unite all young Hereford supporters. While working towards this goal, we will work together, enjoy ourselves and one another, and put the interests of the group above our own."

Example & List of CHA EPDs

	BULL A	BULL B
Calf #1	700 lbs	625 lbs
Calf #2	600 lbs	615 lbs
Calf #3	605 lbs	650 lbs
Calf #4	610 lbs	642 lbs

Average WW of calves from Bull A = 628.8 lbs
Average WW of calves from Bull B = 633.0 lbs
Bull A's WW EPD is 51.5, with an accuracy of 0.75
Bull B's WW EPD is 56.0, with an accuracy of 0.75

The difference in the two bull's WW EPDs is 4.5, which means that **on average** Bull B's calves should be 4.5 lbs heavier than Bull B's calves. This is very close to the actual difference (4.2 lbs) between the average WW of their calves in this example. Even though Bull A has a calf with the highest weaning weight, the rest of the calves show that his EPD should be lower than Bull B's. Large management and contemporary groupings, as well as large numbers of progeny in general will result in an EPD that reflects actual data much more closely. For more information please read the EPD Tools, Averages & Trends (updated twice yearly) and Sire Summary Introduction documents on the CHA website or contact the CHA office.

Calving Ease EPD and Accuracy - calculated using birth weight and calving ease score information. Calving ease EPDs represent the ease with which progeny of an animal are born to first calf heifers. The EPD is expressed as a percent probability, with a higher value representing calves with a higher probability of being born unassisted.

Birth Weight EPD and Accuracy - an indicator of calving ease. Higher birth weight EPDs usually indicates more calving difficulty.

Weaning Weight EPD and Accuracy - reflects progeny growth differences up to 205 days of age.

Yearling Weight EPD and Accuracy - reflects progeny growth differences through to 365 days of age.

Milk EPD and Accuracy - indicates the ability of a sire's daughters to provide their calves with an environment that encourages growth from birth to weaning, through mothering ability and milk production. This EPD is expressed in the expected difference in pounds of calf at weaning.

Total Maternal EPD - also known as Milk + Growth, this EPD combines the milk EPD plus ½ the weaning weight EPD. It is expressed in pounds of calf weaned at 205 days and combines the genetics for preweaning growth and the influence of the maternal environment on the weaning weight of the daughter's progeny.

Maternal Calving Ease EPD and Accuracy - represents the ease with which a sire's daughters will calve as first calf heifers, when compared to daughters of other sires. The EPD is expressed as a percent probability, with a higher value representing daughters with a higher probability of unassisted calving.

Scrotal Circumference EPD and Accuracy - reflects differences in scrotal measurements, taken in centimetres and adjusted to 365 days of age. The SC EPD is positively associated with age at puberty of progeny.

Cow WT EPD and Accuracy - reflects differences in the mature weight of a sire's daughters. This is important as it is related to maintenance energy requirements.

Stayability EPD and Accuracy - reflects differences in the probability that a sire's daughters will remain in production to produce 3 consecutive calves when retained as breeding heifers.

Maternal Productivity Index and Accuracy - combines the EPDs for weaning weight, milk, cow weight and stayability based on their relative economic importance, and then ranks animals within the population.

Feedlot Merit Index and Accuracy - combines the EPDs for calving ease, weaning weight, yearling weight, rib-eye area, marbling and fat based on their relative economic importance, and then ranks animals within the population.

REA EPD and Accuracy - reflects differences in rib-eye area carcass measures in feeder progeny.

Fat EPD and Accuracy - reflects differences in carcass backfat measures in feeder progeny.

Marbling Fat EPD and Accuracy - reflects differences in carcass measures of marbling in feeder progeny, using USDA marbling scores.

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