

The Truths and Myths about **BREEDING** *Values*

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Stud breeders are quite familiar with the term breeding value and most of them use breeding values when selecting their breeding stock. The power of this tool is unparalleled. However, there is still a lot of confusion among some stud- and commercial breeders with regard to the application of this tool. In fact, some breeders shun this tool while others express tremendous enthusiasm about it. The question is: why this mixed reactions? In this article we highlight some possible explanations for this situation.



What a breeding value is and what it is not

There are plenty of definitions of the concept of breeding value in the literature. The one that we find appealing from a practical point of view is that provided by Dr Rick Bourdon from Colorado State University in the United States in his book "Understanding Animal Breeding". Dr Bourdon defines breeding value as the value of an individual or animal as a contributor of genes to the next generation. He further qualifies this definition as follows "the breeding value of an animal is then just the sum of the independent effects of all that animal's genes on a trait". Independent effect refers to the effect of a particular gene irrespective of its "partner" within a locus since genes occur in pairs. The breeding value does not encompass all the genetic effects on a particular trait. Other genetic effects due to interaction between genes within or across loci (i.e. dominance and epistasis) do play a role in determining the expression of a trait or what is called a phenotype. Therefore, the breeding value is just a component of the total genetic effect or the proportion of the total genetic effect that is passed on to the offspring.

Important characteristics of a breeding value

A breeding value cannot be measured or observed. Only the phenotype is observed. The phenotype is a result of the effects of the genes and the environment in which an animal is raised. This phenotype or observations are used to predict the breeding value. This prediction is called an estimated breeding value (EBV) or what the breeders call BLUPs. The BLUPs is an acronym for the methodology used to calculate breeding values and stands for Best Linear Unbiased Prediction. Provided below are some important aspects about breeding values that may help shed some light regarding the misconceptions about EBVs:

i. Breeding values are estimated from performance records

The information that goes into predicting the breeding value includes: performance records of an animal and its relatives and that from genetically correlated traits. The amount of records required to obtain an accurate estimate of the breeding value depends on the heritability of a trait and genetic correlations with other measured traits. As a general rule, fewer records are required to obtain a reliable breeding value for highly heritable traits in comparison to lowly heritable traits.

It is important to draw a distinction between records from ancestors and collateral relatives (e.g. brothers and sisters) vs records from the animal's offspring. Records from offspring are more important because they are a reflection of the genes that an animal carries and therefore receive more attention in the process of predicting breeding values.

ii. Breeding values are expressed as deviations from the reference or base population

The practical application of breeding values is for ranking animals to allow selection of genetically superior animals. Thus, breeding values are expressed as deviation from some reference or base population (e.g. animals born in a specific year). For example, a breeding value of +2kg for birth weight direct indicates that progeny from this animal should be 1kg heavier than those of an average animal from the base population.

iii. The true breeding value does not change but its estimate or EBV does

The true breeding value of an animal is fixed at conception and does not change as the animal grows. In other words, each animal has an inherent ability to perform. As indicated earlier, this inherent ability can only be predicted using performance records.

The true breeding value is therefore never known but can be accurately predicted. The change in the EBV that is often observed is a reflection of the amount of records or information used in the analysis. It is expected that the EBV approximates the true breeding value as more records are used in the BLUP analysis.

The general rule is that the EBV of young animals without progeny (e.g. weaners and yearlings) is less accurate in comparison to the EBV of animals with large number of progeny (e.g. cows and sires). When selecting animals for breeding purposes breeders need to take into account the differences in accuracy of the breeding values. Breeders should be aware that when they use animals with low accuracy EBV the average performance of offspring from these animals might be considerably lower or higher than is suggested by the breeding value. On the other hand, the use of animals with more accurate breeding values should lead to the average performance of the offspring being in line with the EBV.

iv. Half the breeding value is passed to the offspring

According to the Law of inheritance only half the breeding value of an animal is passed on to the offspring. Therefore, each offspring inherits a sample half of the genes from its parent. This sampling of genes creates differences in the exact genes that offspring of the same parent inherit. Given that many genes are involved in quantitative traits the chance that two half-sibs inherited the same set of genes is low. This is the reason why some progeny from an animal may perform worse than expected while others perform better than expected. But the average performance of the offspring will be reflective of the parent's breeding value. It is therefore possible that a bull with high EBV of high accuracy may give birth to a low performing offspring.

Concluding remarks

In this article we have highlighted some of the important aspects about breeding values. The most important of this being the fact that an EBV is a prediction based on performance records and that their accuracy depends on the amount of records available. The quality of the records determines the quality of the estimated breeding values. It is hoped that the information provided here will help clear some of the misconceptions about EBVs and possibly lead to better application of the breeding value technology.

References

R. M. Bourdon. 2000. Understanding animal breeding. 2nd Edition. Prentice-Hall, Inc. Upper Saddle River, New Jersey. USA.

