Increasing EPD Accuracy

Phenotypes combined with genomics paint the clearest prediction picture.

by ***Katie Maupin Miller***

Genomics have offered Hereford breeders a way to identify exceptional genetics more quickly and accurately since the American Hereford Association (AHA) launched genomic-enhanced expected progeny differences (GE-EPDs) in 2012 after working with the scientific community and the National Beef Cattle Evaluation Consortium (NBCEC) to build its own training and validation population.

As Matthew Spangler, University of Nebraska-Lincoln professor and beef genetics Extension specialist, penned in the *Value of Collecting Phenotypes*: "The inclusion of genomic predictors into National Cattle Evaluations (NCE) offers an exciting and powerful tool to increase the rate of genetic gain by increasing accuracy of EPD, particularly of young animals, and by reducing the generation interval if younger sires are used more heavily."

As the use of genomics has become more common within the livestock industry over the last decade, William Herring, livestock geneticist and co-owner of 111 Farms, Whigham, Ga., notes that genomic data consistently enhances the genetic trend for specific traits by 30% year over year across all species. The dairy industry, for example, has used genomic-enhanced performance data to select animals that drove widespread and dramatic industry-wide improvement. However, these genomic models cannot stand alone.

Genotypes alone can't function in the long term he says, explaining that continuously collected phenotypes are necessary to train prediction models over time.

As Spangler notes, genotyping animals does not replace the need for phenotyping. Doing so inherently limits the upper bound of accuracy far below what is possible if additional phenotypes are collected. Genomic predictors should serve as an additional source of information for EPD calculations, not the complete picture.

"Phenotypes plus genotypes equal an ideal situation," wrote Leoma Wells, founder and operator of Data Genie LLC, in *Hereford World* article, Not all Traits are Created Equal. "Geneticists need a random population of actual observed data to analyze and compare against genotypes to isolate which single nucleotide polymorphisms (SNPs) correspond with an expressed phenotype."

As Wells notes, collecting standardized phenotypic data within a contemporary group will help boost the accuracy of the genetic evaluations on any related animals.

Improved accuracy is one of two tremendous benefits that Spangler sees from the continued collection of phenotypic data to support genomic evaluation; the second is establishing a training population.

Table 1: The relationships between true accuracy (r), proportion of genetic variation explained (%GV), and Beef Improvement Federation (BIF) accuracy.

r	%GV	BIF
0.1	1	0.005
0.2	4	0.02
0.3	9	0.046
0.4	16	0.083
0.5	25	0.132
0.6	36	0.2
0.7	49	0.286

From Value of Collecting Phenotypes

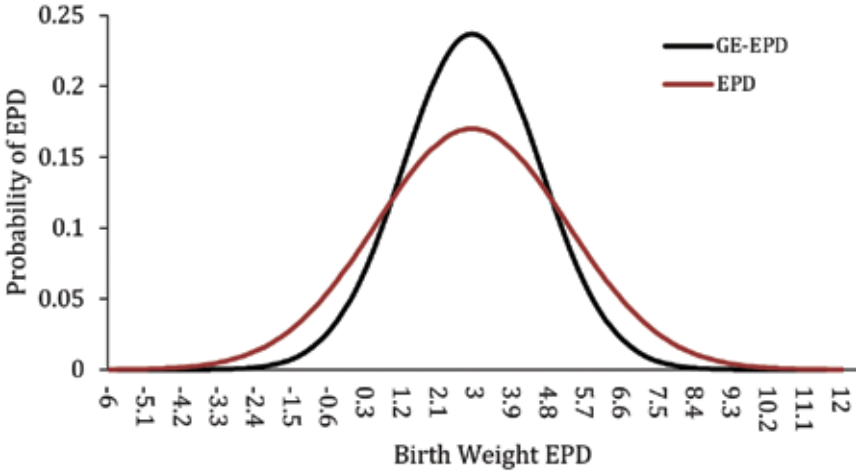
Added accuracy through training

As Spangler writes, a genomic test's effect on EPD accuracy is related to how much genetic variation the marker test explains. The proportion of explained genetic variation is referred to as %GV. Even when the %GV is exceptionally large, the corresponding Beef Improvement Federation (BIF) accuracy is relatively low, suggesting that genomics may add additional information but alone are far from a perfect predictor of an animal's genetic merit.

While genomic predictors may increase EPD accuracy through GE-EPDs, in isolation, they do not increase the BIF accuracy to high levels, which is considered the standard for all U.S. beef breeds. An animal must have progeny with phenotypic data reported to continue to build the accuracy of its EPDs. See Table 1, which shows the relationship between genetic correlation — the correlation between the predicted and true genetic merit, %GV and BIF accuracy.

For an Association to accurately fold genomic evaluations into its performance evaluations, it must have a training and validation population, just as AHA established in 2012. As Spangler notes, these animals ideally have moderate- to high-accuracy EPDs with several progeny's phenotypic data reported to the Association. If an Association is missing routine phenotypic data collection,

Figure 1: Probability of a given EPD for birth weight, based on whether an animal has been genotyped (black line) or not (brown line).



From October Hereford World, How Genomics Can Break the Tie

the initial training of the genomic evaluation will be problematic.

Likewise, even after a genomic evaluation is incorporated into a breed's performance predictions, these genomic predictions must be "retrained" overtime. This means, newly selected animals are routinely being measured for phenotypic traits to build an EPD's accuracy while also providing more information to create even more reliable genomic predictions.

Reducing risk

By constantly informing genomic evaluations with a population's phenotypic data, the GE-EPDs will improve and help producers more quickly select younger genetic outliers and breed changers, hastening the pace of genetic process.

"Implementation of genomic-enhanced EPDs has allowed our breeding program to greatly accelerate the performance of our cattle. Traits such as growth (yearling weight) can be assessed around one year quicker versus data collection, carcass traits are about two years quicker, and maternal traits approximately three years quicker," explains Mark Herring, co-owner of 111 Farms.

With more than 22,000 genes inherited from both an animal's sire and dam, even flushmates can have genetic variation falling along a bell curve. While most siblings' genetic potential would land safely in the realm of as-expected, there will also be poor performers and exceptional progress-driving outliers. Adding genomics into evaluations shrinks these bell curves with added accuracy (see Figure 1), and backing up genomic models with phenotypic data increases the evaluation's accuracy.

"These investments into data collection impact your EPDs by increasing accuracy. Increased accuracy ultimately results in more validated, superior genetics to offer your commercial customers, effectively minimizing their risk," Wells says.

Genomics also enables faster and more accurate genetic prediction of traits that are difficult to measure quickly, such as carcass traits. But these evaluations must be constantly informed by phenotypic data to ensure their accuracy. Genomics can't replace phenotypic data but should work with it to push genetic improvement.

"While these gains in accuracy are impressive, particularly for non-parent animals, it is clear that genomic information alone cannot 'prove' a sire," Spangler says. HW

Editor's Note: Find the *Value of Collecting Phenotypes* factsheet at *ebeef.org*.

Genomic-enhanced expected progeny differences (GE-EPDs) allow commercial and seedstock producers to make more reliable selections and breeding decisions on younger animals. Each animal tested is recognized with the American Hereford Association GE-EPD logo when searching EPDs at *Hereford.org*.