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Hereford Genetic Evaluation

Hereford's genetic evaluation takes quantum leap forward — EPD accuracies calculated.

by ***Bob Hough***

The American Hereford Association (AHA) recently implemented a completely new, ground-breaking genetic analysis. Hereford now has the most sophisticated and up-to-date genetic analysis in the industry.

The analysis includes the use of the Single Step model for incorporation of genomics into expected progeny differences (EPDs), calculation — not estimation — of EPD accuracies, and increased frequency of evaluations. The data input was also changed to decrease bias and improve the precision of the genetic predictions. In addition, two new, economically-relevant trait EPDs were added, and the indexes were updated.

Foundational to the calculation of precise genetic predictions is the input of unbiased performance data. Therefore, AHA's genetic analysis no longer uses any performance data submitted prior to 2001 when Whole Herd Total Performance Records (TPR) were implemented. This removes a tremendous amount of selectively reported historic phenotypic data from the analysis. This culled data had a significant amount of reporting bias, which introduced an unacceptable amount of bias into the genetic predictions.

Reporting bias and genetic prediction precision is demonstrated when an EPD is calculated from equal-size contemporary groups; one containing biased data and the other unbiased data. Because the same amount of information is utilized to calculate the EPD from each contemporary group, the EPDs will have the same accuracy. However, the EPD from the unbiased data will be significantly closer to the true genetic value, making it more precise.

This is a major paradigm shift. Until now, breed associations and genetic analysis companies have measured the quality of their genetic analyses based on the size of their database. However, Hereford has demonstrated that data quality far outweighs data quantity.

The AHA has its genetic predictions calculated at ABRI (Agriculture Business Research Institute) in Australia. They traditionally ran a model where all EPDs were calculated simultaneously in a "correlated" trait model. This way of calculating EPDs made incorporating genomics directly into the model virtually impossible.

To get around this problem in the past, they used a multi-step method in which the genomics were added post analysis in the form of a molecular breeding value (MBV) for each trait. This had severe limitations. It did not make full use of the information contained in the genomics, and the resulting information from the MBVs did not flow up and down the pedigree. Rather, it only affected the individuals genomically profiled.

To solve these problems, ABRI switched to a single-step analysis. This process of analysis uses all-new "BOLT" — biometric open language tools — software that incorporates all the genomic markers directly into the calculations. The BOLT software was developed by Bruce Golden, Ph.D., Dorrian Garrick, Ph.D., and their company, Theta Solutions. However, including up to 50,000 markers per animal in the analysis exponentially increases the size of the mathematical problem to calculate the genetic predictions. To accomplish the Single Step model, ABRI has combined BOLT with new, state-of-the-art hardware capable of doing calculations that people only thought possible on small datasets.

Theta Solutions has its customers utilize Graphic Processing Units (GPU) hardware originally designed for the gaming industry. They are a quantum leap forward in computing power compared to traditional computers, and they are relatively inexpensive. Multiple GPUs are stacked and then run at high voltage and water cooled. An example of the power of these GPUs

combined with BOLT software is their ability to solve traditional EPD calculations in 24 minutes. Normally these calculations take 24 hours. The key is very advanced and innovative programming that lets multiple GPUs solve a problem simultaneously.

The BOLT software incorporates all the markers from each animal directly into the model, similar to how performance data is added like a birth weight. A major difference between the BOLT Single Step model and the model adopted by other companies producing Single Step EPDs is that BOLT weighs markers as to their influence on a trait and discards markers that are not informative. This is done with each iteration of the math that calculates an EPD, which is computationally intensive.

Ultimately, the Single Step model of incorporating genomics significantly improves the accuracy of genetic predictions. BOLT's method of weighing markers further improves accuracy compared to other single-step methodologies.

EPD accuracies have always been estimates of actual accuracy using a BIF (Beef Improvement Federation) method. They were estimated because actually calculating them was too large of a computational problem for existing software and hardware. For the first time among the beef breeds in the North America, Hereford's accuracies will be calculated instead of estimated using the BOLT software and GPU hardware.

Hereford found the BIF estimated accuracies tended to overstate the accuracy of genetic predictions, especially for young animals. Producers will notice right away the calculated accuracies are more conservative than previous ones, but the possible change chart for each accuracy will be far more precise and reliable.

New economically relevant traits

AHA has also added genetic predictions for two new, economically-relevant traits; Sustained Cow Fertility (SCF) and Dry Matter Intake (DMI). The SCF EPD is the probability that once a cow enters the herd at 2 years old, she will remain producing in the herd up to 12 years of age. Since it is a probability genetic prediction, a higher EPD value is more desirable. With DMI, lower intake is desirable, so a lower EPD value is favorable.

In addition, AHA's indexes have been retooled with their basic assumptions reviewed and the two new, economically-relevant traits added. The expertise for these updates was provided by Mike MacNeil, Ph.D. of Delta G, Matt Spangler, Ph.D. of the University of Nebraska, and Larry Kuehn, Ph.D. of U.S. Department of Agriculture Meat Animal Research Center.

Due to the changes in the Hereford genetic analysis, the addition of two new EPDs, and an update of the index assumptions, producers will notice some animals' indexes will have changed significantly. Most of this change will be because of the incorporation of SCF and DMI into the indexes.

Stayability, or SCF, is the biggest single profit driver in a maternal index. As a result, adding the new genetic prediction into their Baldie and Brahman maternal indexes will have a significant impact on them. Dry matter intake will also impact these two indexes, and it will be a major profit driver in the Certified Hereford Beef Index (CHB$). This amount of change generally causes major heartburn for producers, but the updated indexes are a significant improvement over the previous ones.

Also new to AHA's genetic analysis is it will be run weekly instead of 10 times a year, as was done previously. A great amount of time and effort was put into this to automate the process. Under the new system, the database will automatically download to ABRI weekly, which will trigger a new genetic analysis to be run. The data will then automatically be uploaded to AHA for review and weekly release. The nice thing is, if any problems are found, they can be solved with the next week's run. Before, it took a month for problems to be corrected.

With these changes, Hereford now joins Angus, Beefmaster, Brangus, Charolais, and Santa Gertrudis running a Single Step model for the incorporation of genomics into its genetic predictions. With the new BOLT software, Hereford genetic predictions should lead the industry in terms of accuracy.

Other improvements Hereford has made to its analysis include: data pruning to remove bias; calculation of actual EPD accuracies; more frequent genetic analysis; calculation of genetic predictions for two new economically-relevant traits; and updated indexes. All this adds up to a significant amount of change for Hereford breeders and the commercial customers who use Hereford genetics.

In general, people dislike change no matter how positive it will be in the long run, and these changes will take some getting used to. Ultimately, Hereford stakeholders will have the most precise and reliable genetic predictions upon which to make objective decisions. This can only help the breed in the years to come and will help assure Hereford genetics are having a positive impact on the beef industry. HW

Editor's Note: Bob Hough, Ph.D., is the retired executive vice president of the Red Angus Association of America and a freelance writer. This article was first published in the *Western Livestock Journal* on Dec. 22, 2017.