BY THE NUMBERS

by Stephen Miller, Angus Genetics Inc.

Performance and Genomics Working Together

In last month's By The Numbers column, we began discussing how performance and genomics work together to determine non-parent expected progeny differences. This month, we continue that discussion.

This pair of articles presents the results of some special research from the American Angus Association's weekly genetic evaluation. The research is to determine how expected progeny differences (EPDs) generated at different points in time, with different sources of information generate EPDs with different levels of predictability. We identified 178 benchmark sires with 25 or more recorded progeny, and are using the EPDs generated based on this progeny information as the closest "truth" to these bulls' genetic merit that we have available.

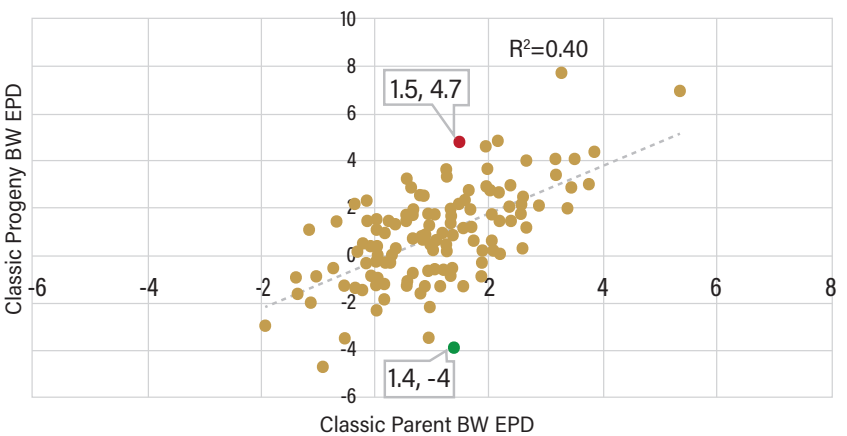
Last month's article provided the overall picture with an EPD generated based on parent information plus a genotype revealing a sizable increase in accuracy compared to an EPD based only on parents, or an EPD based on parents plus the animal's own record. This month's article dives deeper into the results around birth weight and looks into the predictability on specific bulls.

The comparison of the benchmark bulls' birth weight (BW) EPD under each of the four test EPD scenarios and the same benchmark bulls' EPDs based on the classic progeny evaluation are presented in Figures 1-4. Figure 1 represents the ability of the bulls' classic parent average EPDs to predict future EPDs based exclusively on progeny performance. Each dot on the graph represents one of the 135 sires with a BW record in the evaluation. Presented on the graph is an R^2 value of 0.40, which is a statistic that measures the degree of relationship in this scenario between parent average EPDs and future progeny-based EPDs. In other words, 40% of the variation we see in future progeny-based EPDs is explained by the parent average EPD. A perfect relationship would be 100% and no relationship would be 0%.

The effect of adding information can be seen as we move from Figures 1 through 4. Figure 2 (on page 42) shows how adding the bull's own birth weight record into the evaluation improves the ability to predict future progeny performance, with an R^2 value of 0.44. So the R^2 value did improve, but not by a lot. This indicates that adding these

Figures 1-5: ***Ability of EPDs with different sources of information to predict future progeny performance across 4 scenarios for BW and in the highest predictability scenario (IMF) traits in Angus's genetic evaluation.***

Figure 1: *Classic Parent BW*



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benchmark bulls' own birth weight records into the evaluation really did not result in an EPD that was a lot more closely related to their EPD based on 25 or more progeny, compared to just using parent average alone.

Now let's look at how a genotype on the bull can predict future progeny performance in Figure 3. Here the R^2 value has jumped to 0.65, as the dots on average move closer to the line. This EPD based only on the genotype of the bull, without his own record, is doing a much better job at predicting future progeny performance than the classic parent average EPD or the classic EPD including the bull's own record. When we add the bulls own birth weight record to this genomic EPD in Figure 4, we see very little improvement in predictability with an increase in R^2 from 0.65 to 0.66. Once the animal is genotyped, there was little additional predictive value gained from adding in their own performance record on these bulls.

However, even though accuracy doesn't improve significantly, it's still imperative that breeders turn in birth weights. The EPD system hinges on the relationship between actual performance and true breeding value overall. The heritability for birth weight of 0.46 is a measure of this relationship across the population. The genomic accuracy is only made possible with performance measures in the analyses. So these measures remain important for the Angus evaluation, but the weight put on any one measure on a single animal is reduced with genomics.

Two bulls are highlighted in Figures 1-4 as a red dot and a green dot, along with a call out that shows the BW EPD in the test vs. their progeny-based EPD. These dots were picked as they were outliers (far from the line) in the classic parent EPD (Figure 1). Both of these bulls have very similar parent average EPDs, but very different EPDs based on progeny.

Let's focus first on the bull represented by the red dot. Based on progeny performance, this red dot bull is a +4.7 BW EPD. But if we just had his parent average EPD and no genomics, we estimate his BW EPD at +1.5. When we add in his own record, he is +1.1, actually a tick farther from his progeny EPD. Genomics, on the other hand, moves this bull to +2.7, closer to what he proved out to be with his progeny.

The bull represented with the green dot has a progeny-based EPD of -4.0, but a parent average of 1.4. This bull's own record pulls his EPD closer to where he ends up with progeny at -0.2. An EPD based on genomics only moves him to -2.4. With his own record added he would move to a -2.6, the non-parent EPD he would be assigned in the weekly evaluation.

These two contrasting bulls show the limitation of EPDs based on phenotype. Overall the animal's phenotype is related to their underlying true genetic value. The red-dot bull is an example of one whose own performance was

Figure 2: *Classic Performance BW*

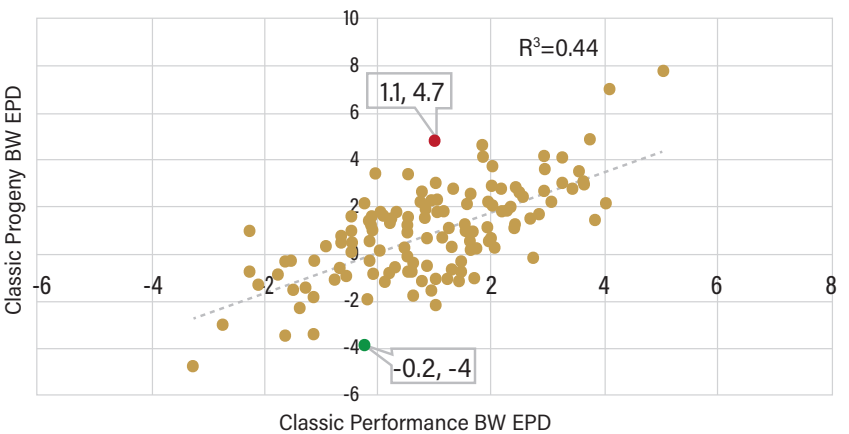
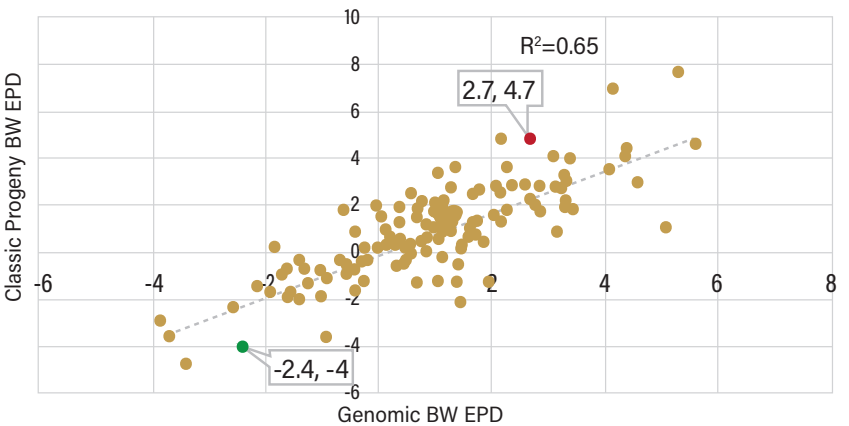


Figure 3: *Genomics BW*



contrary to his genetic value, where the green dot bull had a performance record that lined up better with his true genetic value. Overall the EPDs are correct on average. But until a bull is very high-accuracy, breeders need to be aware of the limitations in the technology.

Besides BW, the same set of analyses were done for WW, yearling weight (YW) and intramuscular fat (IMF) EPDs. The graphs for each show a very similar pattern to BW. The IMF graph (Figure 5) is presented to illustrate the scenario with the highest predictability. Take note of how tightly the dots are clustered around the line. The R^2 values for all scenarios are presented in Figure 6. The same graph was presented in the March 2020 By The Numbers using all 178 sires. The graph in Figure 6 included just the bulls with a record in the evaluation for each trait which has generally increased the predictability estimates.

These tests illustrate how the EPDs generated in the weekly Angus genetic evaluation are improved with genomics. The EPDs of a genotyped non-parent is more predictable of the animal's true genetic merit based on progeny. All of this increased prediction accuracy is based on the data submitted by members, so continued submission of performance data remains important. Genotyping young sale bulls early in their life is highly recommended as a way for suppliers to increase the predictability of the genetics they offer to their commercial customers. AJ

smiller@angus.org

Editor's note: If you have questions, please contact the Performance Programs department at 816-383-5100.

Figure 4: *Genomics + Performance BW*

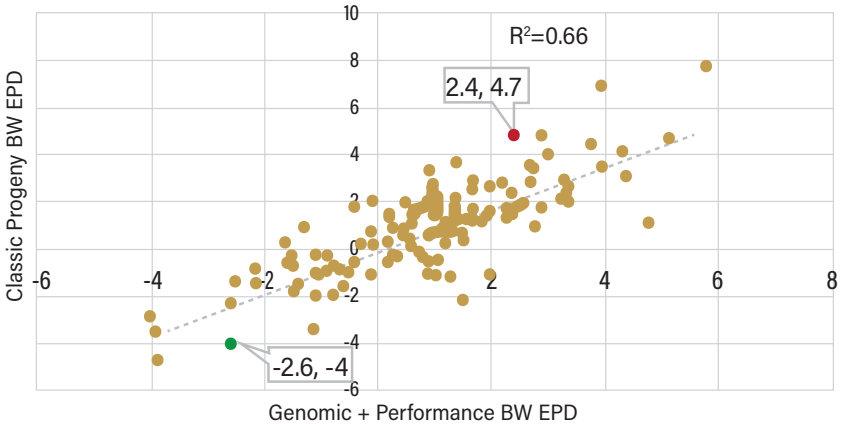


Figure 5: *Genomics + Performance IMF*

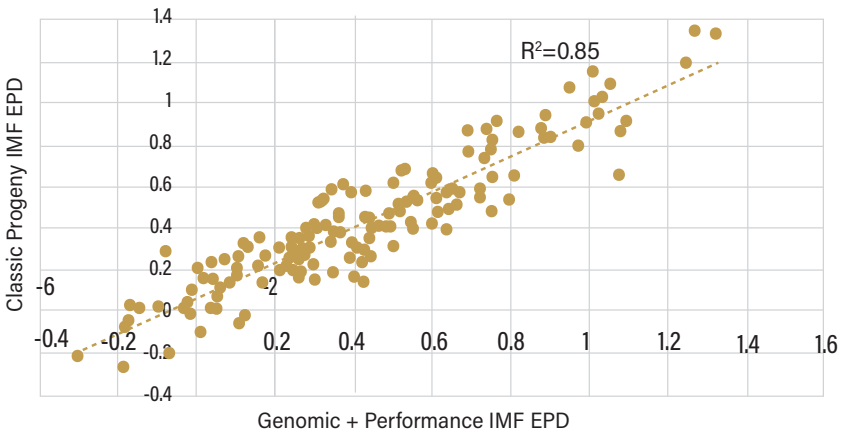


Figure 6: *Ability of EPDs with different sources of information to predict future progeny performance across 4 traits in Angus's genetic evaluation.*