UF-Gainesville Beef Cattle News Corner

What heritability and hybrid vigor really mean for producers.

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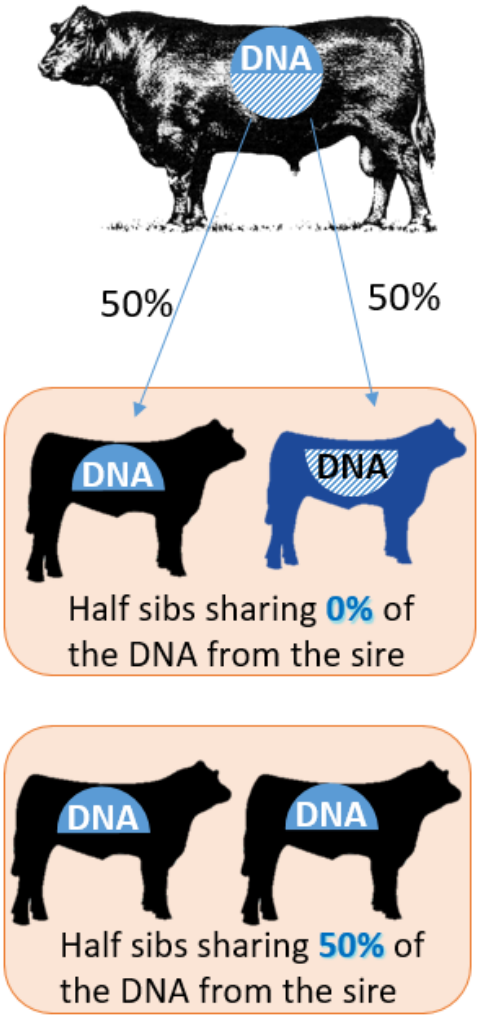
Heritability tells us how much of the variation in a trait is due to genes. So what does heritability mean to a producer? Heritability gives us an idea of how much progress can be made through selection; the higher the heritability for a trait the more progress can be made. Heritability can range from 0 to 1 (0% to 100%). In a trait with a heritability of 0 none of the variation would be genetic while in a trait with a heritability of 1 all of the variation would be due to genetics. Traits with a heritability of less than 0.2 are typically considered to be have low heritability. Reproductive traits such as pregnancy rate are lowly heritable, and in fact, many traits that are economically important to cow calf producers tend to have low heritabilities. Traits with a heritability between 0.2 and 0.4 are generally considered moderately heritable and most growth traits, such as average daily gain fall into this category. Finally, traits with a heritability above 0.4 are considered highly heritable. Size and carcass traits, such as hip height and ribeye area are highly heritable. These heritability values tell us how quickly we can make a difference in a trait due to selection. For example, we can change the size of cattle through genetic selection much more quickly than we can change pregnancy rates, because size is more heritable.

There are many misconceptions about heritability. Remember, heritability tells us how much progress we can make using selection to change future generations, not the current animal. Sometimes an animal will mistakenly be described as having a heritability, but this is not the case. The higher the heritability *for the trait,* the more an individual's progeny will resemble them for that trait. For example, heifers out of large cows will most likely also be large. Another major misconception is, if a trait has a heritability of 0 then that trait has nothing to do with genes. Remember, heritability tells us how much of the *variation* in a trait is due to genes. If a trait has no variation it will have a heritability of 0 because there is no room for selection. For example, all cattle have four legs (except in cases of very rare congenital deformities). The fact that cattle have four legs is controlled by genes coded in the DNA of all cattle. However, even though leg number is controlled by genes, its heritability is 0 because there is no variation and there is no way to select for different numbers of legs. Another misconception is that heritability never changes. If we select for a certain trait for many generations we will narrow the variation and reduce the heritability. It can be very beneficial to get rid of inferior genetics at first but as you continue to select for better animals there is less and less room for improvement.

So if heritability tells us how much of the variation in a trait is due to genetics, what causes the rest of the variation? A large part is controlled by environment. Take pregnancy rate as an example: yes, genetics do play a role but the biggest factor in getting cows bred is environmental. Cattle on a poor plane of nutrition rarely breed; cows have to be fed to get bred. Good management is key to improving less heritable traits. Even for traits that are more heritable, poor management or environment can keep cattle from reaching their genetic potential.

There is a third factor that affects traits that is genetic but not heritable. This has to do with random combinations of genes that exist in an individual but will not get passed on to the offspring. The

best example of this is hybrid vigor. Hybrid vigor (also known as heterosis) is most simply defined as the increased performance of a crossbred animal compared to the average of the purebreds.



An F1 animal results from crossbreeding two purebred animals and has the most possible hybrid vigor. Every animal has two copies of each gene, one from each parent. In an F1, every single combination has a gene from each breed, which is what gives the F1 its hybrid vigor. The F1's parents passed on its genes but not the combination, which is why hybrid vigor is not heritable. Heritability only describes genes that are going to be passed on. So why is hybrid vigor so important? For traits that are lowly heritable, especially the economically important ones mentioned earlier, hybrid vigor greatly improves performance. Typically, the less heritable a trait the bigger impact hybrid vigor will have on performance.

Unfortunately, we only know for certain what the hybrid vigor is in an F1. An animal always passes on half its genetics to its offspring. If we cross purebred Brahman and Angus to make an F1 we know that the Brahman parent can only give Brahman genetics to its offspring and vice versa for the Angus. So what happens when we have an F1 Brahman-Angus parent? The F1 is still going to pass on half its genes but which half it passes on is completely random. On average we would assume it would pass on an equal numbers of Brahman and Angus genes but really it could pass on anywhere from 100% Brahman genes to 100% Angus genes. The percentage that gets passed on changes for every offspring. Every time a sperm or egg is produced genes combine randomly, so theoretically one offspring could get 100% Brahman genes while another offspring gets 100% Angus genes, which is why even full siblings can perform very differently. This can make predicting performance difficult, but with the onset of new genetic technology we can tell exactly which genes a calf got from its parents and make better predictions and selection decisions.

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