BY THE NUMBERS

by Kelli Retallick, Angus Genetics Inc.

New Breeding Tools to Tackle Fertility

Failure of females to become pregnant directly affects the economic sustainability of every cow-calf producer. In October 2008, The Beef Site *reported infertility caused a reduction in revenue that exceeded $1.06 billion to the entire beef industry.*

Since that time, the American Angus Association has taken steps to provide tools to members and users of Angus genetics to reduce the burden infertility plays on profitability. In the summer of 2011, the heifer pregnancy (HP) expected progeny difference (EPD) was officially added to the *Sire Evaluation Report.* This tool aims to identify sires that will produce daughters that will have a higher probability of settling as virgin heifers.

In addition, ongoing research around functional longevity continues as the Association looks to identify genetic prediction tools to identify sires that produce females that stay active and productive in the herd for a longer lifetime.

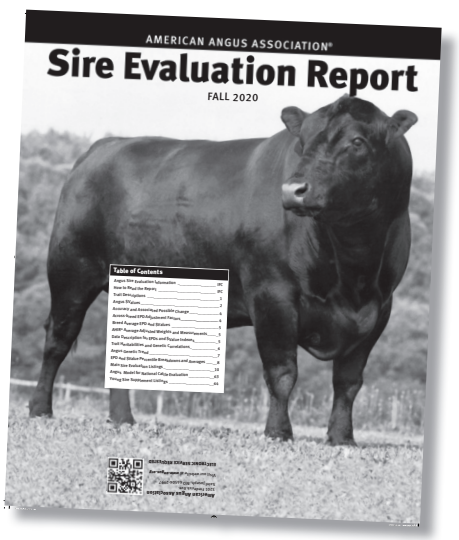
Still, with all the research that has or is taking place, the team at Angus Genetics Inc. (AGI) was left searching for more ways to tackle this tremendously important trait. Sitting on mounds of data and looking at how other industries have approached fertility issues, the team began to explore the potential existence of haplotypes negatively affecting fertility.

Haplotypes are small chunks of DNA inherited together from generation to generation. Even though haplotypes can be used to track traits such as coat color and polledness, the dairy industry has widely used haplotype research to address decreasing fertility rates.

A lesson from dairy

While haplotypes are relatively new to the beef industry, the dairy industry has utilized the labeling of haplotypes to address fertility loss since 2011. Currently, four major dairy breeds — Holstein, Brown Swiss, Ayrshire and Jersey — have taken advantage of their industry's adoption of genomic testing to leverage these breeding tools. The ramifications of these listed haplotypes are dependent upon the frequency in which they occur in the population.

Most published dairy haplotypes are relatively low in frequency. For example, Holstein haplotypes have frequencies ranging from approximately 1% to 5%. Identification and publication of these haplotypes when the frequency is low has been key in the effort to track and negate unnecessary losses in fertility.



Left unidentified, a sire carrying a harmful haplotype could rise to dominance in a breed because of his outstanding genetic status for an economically important trait. This could lead to a large number of producers utilizing those genetics, thereby increasing the frequency of the harmful haplotype.

Despite the negative effect of haplotypes, the dairy industry realized the immediate removal of carriers from the population was not the most prudent course of action.

Take Pawnee Farm Arlinda Chief, a popular Holstein sire born in 1962 as an example. Because his daughters were such prolific milk producers, Chief is responsible for approximately 14% of the total DNA makeup of the Holstein breed.

Unfortunately, Chief carried a harmful mutation — a haplotype that negatively affected fertility. When mated to dams carrying the same haplotype through some level of inbreeding, embryos with two copies of the haplotype were created 25% of the time, thereby resulting in early embryonic death.

Unidentified for decades, the haplotype proliferated through Chief's progeny and grand progeny until genomic testing brought it to light.

During the past three decades, it is estimated Chief has been responsible for more than 500,000 embryonic deaths at a cost of nearly $420 million to the dairy industry. However, the more astonishing number is the estimated $30 billion in increased milk production Chief's genetics have generated during the same time period.

For this reason, the dairy industry has sought to manage haplotypes by avoiding carrier-to-carrier matings rather than seeking to immediately eliminate them. In doing so, favorable genetics can be retained as the unfavorable haplotypes are eliminated over time.

Ongoing research

Using the database of nearly 850,000 genotypes alongside breeding and calving records, the AGI team has been working to understand if these types of haplotypes exist in the Angus population. While evidence exists the haplotypes are present, breeders should acknowledge a few things.

1. **Haplotypes are breeding tools.** Immediate elimination of animals possessing one copy of a harmful haplotype is not necessary. With the use of genotyping technology and artificial insemination (AI), members will be able to selectively mate around these nuisances while maintaining the genetic value they have built into their herds for generations.
2. **Haplotypes are not considered genetic conditions.** While similar in mode of inheritance, identifying a haplotype does not indefinitely pinpoint the exact mutation, as is the case with genetic conditions. For this reason, haplotypes are not considered genetic conditions, and no registration restrictions will exist for carriers.
3. **Animals would need to be tested with a full genetic profile to receive haplotypes.** Because haplotypes are tracking chunks of DNA inherited throughout the genome, haplotype status cannot be established with a stand-alone test. No additional testing fees will be incurred by the member to receive haplotype status, similar to the parentage test included with the $37 genomic profile today.

Opportunity is on the horizon. Tracking haplotypes that reduce fertility is one more tool breeders can use to be as profitable as possible.

To learn more about what haplotypes are or how they are identified, check out these previously published "By The Numbers" articles: "From SNP to Haplotypes" from the February 2020 *Angus Journal;* and "How are haplotypes that affect fertility detected?" from the July 2020 *Angus Journal*. AJ

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Editor's note: If you have questions, please contact the AGI team at 816-383-5100.