



A NEW GENETIC BREEDING TOOL ON THE HORIZON

By Angela Hughes DVM PhD
Veterinary Geneticist • Mars Veterinary

Many breeders face difficult decisions when choosing potential breedings. You have many things to consider in terms of health, physical, and behavioral traits in your quest to produce the best possible puppies. While you can consider what a dog looks like and acts like, and even what their relatives are like, you may still have some concerns about potential health issues that could arise based on your breed and family history. Certainly there are genetic mutations that have been identified for some diseases in particular breeds; however, there are still many unknowns that remain making your breeding decisions still very difficult. Thankfully, recent advances in veterinary genetics have expanded our ability to look at the DNA of breeding dogs and provide you with a better understanding of the specific chromosomal patterns (haplotypes) your dogs carry, allowing you to use that information in your breeding decisions and work to maximize the genetic diversity or heterozygosity in your puppies.

Why should you be concerned about the genetic diversity of your puppies? It is an important concept for the overall health of the breed and for your breeding program in particular since a number of studies in a variety of breeds have shown that decreased diversity can impact the fertility, litter size, working ability, and health of dogs. In fact, many breeds have a relatively small population and could be considered the equivalent of an endangered species. Since we don't want to have our dogs end up like the cheetahs which are having significant medical and reproductive problems due to their lack of genetic diversity, it is important to consider genetic diversity as a factor in our breeding programs to, at minimum maintain and, if possible, increase the genetic diversity within each breed.

Optimal Selection™ by Mars Veterinary is a new blood test that uses over 300 genetic markers to analyze your dog's DNA

on many key chromosomes. You can then consider a number of "virtual matings" to the dogs you are considering to predict the potential sire's and dam's chromosomal similarities and differences. By minimizing the risk of genetic overlap, you are given the opportunity to diversify the genetic makeup of your puppies and reduce the risk of autosomal recessive medical conditions while still selecting for your stud dog and bitch's attributes.

"But I already consider genetic diversity when I calculate inbreeding coefficients." The inbreeding coefficient is a measure of the relatedness of the ancestors for the offspring in a litter; however, it is still a relatively rough measure as it will vary depending on the number of generations considered and is an average for the entire litter. Within that litter, the puppies can vary quite widely in terms of their genetic diversity within themselves (heterozygosity) or as compared to the breed as a whole (for example, one littermate may carry a particularly rare haplotype for the breed). Thus, a tool like Optimal Selection™ which can evaluate each dog at the genetic level would give you significantly more information than an inbreeding coefficient alone. Within the dogs that you are considering in your breeding program, you can now include information on their specific DNA haplotypes to make educated decisions with regard to the diversity of the mates in your program. Optimal Selection™ utilizes a scoring system based on the compatibility of the chromosomes analyzed between the dogs. Lower scores are preferred since they show that these dogs are more likely to produce puppies with less risk of doubling up on un-selected regions that may cause disease while maintaining the desired traits that you originally selected the dogs for. It is very important to remember that Optimal Selection™ is not a way of determining who is a "good" or "bad" dog, instead, it is a matter

OPTIMAL SELECTION™

A NEW GENETIC BREEDING TOOL ON THE HORIZON

continued from page 234

of which dog would be better in this particular mating. Even if one stud is not a great match for this bitch, there are likely many others that he would work well with and produce healthier puppies with as a result. It is also up to you to verify the physical and behavioral traits of each potential mate to ensure that they have all the qualities you value in your breeding program regardless of the DNA profile.

“But there are areas that I want to have homozygosity or genetic overlap since that is how I get the recessive traits that I am aiming for.” This is a common concern, however, since you are selecting the potential mates based on all the physical and behavioral traits you can control through selection, those traits should carry through as they would normally. You are in complete control of your breeding program. Within your program, Optimal Selection™ can help you gather additional information about the areas of the genome that you are not specifically selecting for and thus minimize overlap in those regions.

“Dandie breeders have been using this tool with great success to date and they have increased their average number of puppies produced in Optimal Selection™ litters to over 4.0 compared to the breed average of 2.75 puppies per litter.”

Using Optimal Selection™ is an easy process beginning with picking your potential mates based on their family lines, temperament, conformation, and working ability. Next, you obtain Optimal Selection™ kits for each dog being considered for pairing, have your veterinarian collect a blood sample from each, and mail the kits in for testing. Within 2-3 weeks you will be emailed individual reports for each dog tested which show their chromosomal results. You can then request a match report that shows the virtual matings for all the dogs you are considering so that you can compare the breeding scores for each potential mating and examine any particular chromosomes of interest (e.g. chromosome 12 for the immune system) to help make your final breeding selection.

Let's look at an example to get a better feel for how this will work. We have a bitch named Guinevere and we are considering mating her to two brothers, Excalibur and Arthur, or a third dog, Lancelot. Each of these studs has proven himself in the ring, has a nice head, good structure, have passed all the health screens for hip dysplasia and eye problems, and they all have

great temperaments. While all of them meet our standards, which one should we ultimately choose? Performing Optimal Selection™ on these dogs gives us the following breeding scores when compared with Guinevere: Excalibur 3.25, Arthur 2.00, and Lancelot 5.75. Remember that a lower breeding score shows a lower risk of overlap; Arthur would make the best match for Guinevere, although his brother Excalibur would be a good second choice. Lancelot has a number of areas of overlap with Guinevere which could cause their puppies to have less diversity and could lead to more health concerns as a result. In fact, comparing Lancelot with our other bitch, Morgana, we find that she is a much better match for him with a breeding score of 2.50.

To prove the effectiveness of Optimal Selection™, Mars Veterinary has spent over two years conducting a pilot study with the Dandie Dinmont Club of America. The Dandie breeders are extremely dedicated to preserving this wonderful breed and have been very helpful in the course of this study. We first performed an extensive analysis of the breed's chromosomal haplotypes to better understand their current genetic state and found that there are chromosomes with a large degree of heterozygosity and others that have lower diversity which may be related to traits that breeders have “fixed” in the breed as they are the features that are breed-defining such as coat texture and leg length. Breeders could then perform Optimal Selection™ virtual matings for the dogs that they were considering to help determine final mate selection. Dandie breeders have been using this tool with great success to date and they have increased their average number of puppies produced in Optimal Selection™ litters to over 4.0 compared to the breed average of 2.75 puppies per litter. These Dandies puppies appear sound and some are doing very well competitively. Many additional litters are in progress and all the litters are being followed to collect data on soundness, temperament, health, competition, and reproduction over the course of their lives.

While Optimal Selection™ should not be the only means of determining a desirable mating, the diversity of the dogs should be included as a factor in order to maintain the genetic health of our breeds and our dogs.

Optimal Selection™ will be available in the US for most AKC breeds beginning this summer. For more information about using the Optimal Selection™ genetic breeding analysis in your breeding program please visit www.marsveterinary.com/breederservices.

