Papillon Club of America
Health & Genetics

POPULAR SIRE SYNDROME AND CONCERNS OF GENETIC DIVERSITY

By : Jerold S. Bell
Tufts University School of Veterinary Medicine

There is a tendency for breeders to breed to the male who is the top-winning dog. This can also occur with a popular dog that has OFA excellent hip conformation, or has produced no epileptic offspring in matings to epileptic dams. Regardless of the popularity of the breed, if a large portion are breeding to a single stud dog, (the popular-sire syndrome), the gene pool will drift in that dog's direction and there will be a loss of genetic diversity. Too much breeding to one dog will give the gene pool an extraordinary dose of his genes, and this will include whatever detrimental recessives he may carry, to be uncovered in later generations. This can cause future breed-related genetic disease through what is known as the founder's effect.

Along with the thrill of owning a popular sire, comes your responsibility to the breed. Over time, you will find out what detrimental genes he carries. Hopefully these will cause minor faults, but occasionally they may cause genetic disorders. The true measure of a conscientious breeder is how this knowledge is disseminated to the owners of the next generation.

Purebred dog breeds have closed studbooks. No new genes are available to the breed, except from infrequent mutations that are usually not desirable. Considering a breed as a whole, genes cannot be gained through selective breeding; they can only be lost. This has lead breeders to question whether a pure breed can go though hundreds of years of selective breeding and still maintain its health and viability.

All genes come in pairs: one from the sire and one from the dam. If both genes are of the same type, the gene pair is homozygous. If the two are different, the gene pair is heterozygous. While each dog can have a maximum of two different genes in a pair, many different genes are potentially available to be part of the pair. The greater the number of genes that are available to each pair, the greater the breed diversity.

Breeders underestimate the amount of diversity that can be present in a breed; even one with a limited group of founders. A molecular genetic study of the Chinook dog breed, which was reduced to four dogs in the 1970s, showed that there was significant genediversity and heterozygosity in the breed.

The studbook for the Thoroughbred horse has been closed for more than 300 years. However, researchers have found that on average 63 percent of the variable gene pairs are heterozygous and that 4.7 genes are potentially available to each pair. This diversity is present in spite of the fact that 95 percent of the breed traces back to a single founder male.

Some breeders express concern that inbreeding depression may affect the viability of their breed. The consequence of inbreeding depression is not due to a general effect from a high level of homozygous gene pairs. The problem that inbreeding depression causes in purebred populations, stems from the effects of deleterious recessive genes. When homozygous, they cause impaired health. Lethal recessives place a drain on the gene pool, through smaller litter size or neonatal death. Other deleterious genes can cause disease or impair immunity. If there is no breed diversity in a gene pair, but the particular homozygote that is present is not detrimental, there is no negative effect on health.

The characteristics that make a breed reproduce true to its standard are based on non-variable (homozygous) gene pairs.

The Doberman Pincher breed has a problem with von Willebrand's disease; an autosomal recessive bleeding disorder. Genetic testing has found that the defective gene is present in 77 percent of Dobermans. Doberman breeders can test and identify carrier and affected dogs. They can decrease the defective gene's frequency by breeding carriers to normal-testing dogs and selecting quality, normal-testing offspring for breeding. By not just eliminating carriers, but replacing them with their normal-testing offspring, genetic diversity will be preserved.

The perceived problem of a limited gene pool has caused some breeders to discourage linebreeding and promote outbreeding in an attempt to protect genetic diversity. However, it is a fallacy that each dog must carry the diversity of the breed. Studies in genetic conservation and rare breeds have shown that this practice actually contributes to the loss of genetic diversity.

By uniformly crossing all "lines," or families of dogs in a breed, you eliminate the differences between them, and therefore the diversity between individuals. This practice in livestock breeding has significantly reduced diversity and caused the loss of unique rare breeds. The process of maintaining separate lines, with many breeders crossing between lines and breeding back as they see fit, maintains diversity in the gene pool. It is the varied opinion of breeders as to what constitutes the ideal dog, and their selection of breeding stock that maintains breed diversity.

A basic tenet of population genetics is that gene frequencies do not change from the parental generation to the offspring. The gene frequencies will remain the same regardless of the homozygosity or heterozygosity of the parents, or whether the mating represents an instance of outbreeding, linebreeding, or inbreeding. If some breeders outbreed, and some linebreed to certain dogs that they favor while others linebreed to other dogs that they favor, then breedwide genetic diversity is maintained.

The loss of genes from a breed's gene pool occurs through selection: the use and non-use of offspring. If a popular sire is used extensively, gene frequencies, and the gene pool can shift towards his genes, limiting the breed's genetic diversity. On the other hand, dogs that are poor examples of a breed should not be used simply to maintain diversity. Related dogs with desirable qualities will maintain diversity and improve the breed.

Breeders should concentrate on selecting toward the breed standard, based on ideal temperament, performance, and conformation, and should select against the significant breed-related health issues. If breeders continually breed healthy, superior examples of their breed and avoid the popular-sire syndrome, the genetic health of the breed can be maintained.

BIOGRAPHICAL SKETCH OF : JEROLD S. BELL

DVM is a Clinical Assistant Professor, and Director of the Clinical Veterinary Genetics Course for the Tufts University School of Veterinary Medicine. He was trained in genetics and genetic counseling at Michigan State University, and the University of Missouri. His DVM is from Cornell University. Dr. Bell lectures to all-breed and individual breed dog clubs. He is the project administrator of genetic disease control programs for national parent clubs. He performs genetic counseling through Veterinary Genetic Counseling, and practices small animal medicine at Freshwater Veterinary Hospital in Enfield, CT. He and his wife breed Gordon Setters