Papillon Club of America Health & Genetics

THE INS AND OUTS OF PEDIGREE ANALYSIS

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As breeders, you engage in genetic "experiments" each time you plan a mating. The type of mating selected should coincide with your goals. Outbreeding brings together two animals less related than the average for the breed. This promotes more heterozygosity, and usually more variation in a litter. A reason to outbreed would be to bring in new genes or traits that your breeding stock does not possess. Outbreeding can also mask the expression of recessive genes, and allow their propagation in the carrier state.

Linebreeding attempts to concentrate the genes of a specific ancestor or ancestors through their appearance multiple times in a pedigree. The ancestor should appear behind more than one offspring in the sire and dam's pedigree. Otherwise you are only linebreeding on the single offspring. A linebreeding may produce an offspring with magnificent qualities. However, if those qualities are not present in any of the ancestors that have been linebred on, the individual may have a wonderful show career, but it may not breed true. Careful selection of mates is important, but careful selection of offspring from the resultant litter is also important to fulfill your genetic goals. Without this, you are reducing your chances of concentrating the genes of the linebred ancestor.

Inbreeding significantly increases homozygosity, and therefore uniformity in litters. Inbreeding can cause the expression of both beneficial and detrimental recessive genes through pairing up. Inbreeding cannot change, or create undesirable genes. It only exposes them through homozygosity. Inbreeding can also exacerbate a tendency toward disorders controlled by multiple genes, such as hip dysplasia and congenital heart anomalies. Unless you have prior knowledge of what milder linebreeding on the common ancestors has produced, inbreeding may expose the offspring (and buyers) to extraordinary risk of genetic defects. Research has shown that inbreeding depression, or diminished health and viability through inbreeding is directly related to the amount of detrimental recessive genes present. Some lines can thrive with inbreeding, and some cannot.

The inbreeding coefficient is an estimate of the percentage of all the variable gene pairs that are homozygous due to inheritance from common ancestors. It is also the average chance that any single gene pair is homozygous due to inheritance from a common ancestor. In order to determine whether a particular mating is an outbreeding or inbreeding relative to your breed, you must determine the breed's average inbreeding coefficient. The average inbreeding coefficient of a breed will vary depending on the breed's popularity or the age of its breeding population.

For the calculated inbreeding coefficient of a pedigree to be accurate, it must be based on several generations. Inbreeding in the fifth and later generations (background inbreeding) often has a profound effect on the genetic makeup of the offspring represented by the pedigree. In pedigree studies, the difference in inbreeding coefficients based on four versus eight-generation pedigrees varied immensely. A four-generation pedigree containing 28 unique ancestors for 30 positions in the pedigree could generate a low inbreeding coefficient, while eight generations of the same pedigree, which contained 212 unique ancestors out of 510 possible positions, had a considerably higher inbreeding coefficient. What seemed like an outbred mix of genes in a couple of generations appeared as a linebred concentration of genes from influential ancestors in extended generations.

Many breeders plan matings solely on the appearance of an animal and not on its pedigree or the relatedness of the prospective parents. This is called assortative mating.

Breeders use positive assortative matings (like-to-like) to solidify traits, and negative assortative matings (like-to-unlike) when they wish to correct traits. Some individuals may share desirable characteristics, but they inherit them differently. This is especially true of polygenic traits, such as ear set, bite or length of forearm. Breeding two phenotypically similar but genotypically unrelated individuals together would not necessarily reproduce these traits. Conversely, each individual with the same pedigree will not necessarily look or breed alike. Therefore, matings should be based on a combination of appearance and ancestry.

Rare breeds with small gene pools have concerns about genetic diversity. Some breed clubs advocate codes of ethics that discourage linebreeding or inbreeding, as an attempt to increase breed diversity. The types of matings utilized do not cause the loss of genes from a breed gene pool. It occurs through selection; the use and non-use of offspring. Regardless of the popularity of the breed, if everyone is breeding to a single stud, (the popular sire syndrome) the gene pool will drift in that individual's direction and there will be a loss of genetic diversity. The frequency of his genes will increase, possibly fixing breed related genetic disease through the founder's effect. If some breeders linebreed to certain individuals that they favor, and others linebreed to other individuals that they favor, then breed-wide genetic diversity is maintained. Animals who are poor examples of the breed should not be bred simply to maintain diversity. Related individuals with desirable qualities will maintain diversity, and improve the breed.

If you linebreed and are not happy with what you have produced, breeding to a less related line immediately creates an outbred line and brings in new traits. Repeated outbreeding to attempt to dilute detrimental recessive genes is not a desirable method of control. Recessive genes cannot be diluted; they are either present or not. If an individual is a known carrier or a high carrier risk through pedigree analysis, it can be retired from breeding, and replaced with one or two quality offspring. Those offspring can be bred, and replaced with quality offspring of their own, with the hope of losing the defective gene.

Trying to develop your breeding program scientifically can be an arduous, but rewarding, endeavor. By taking the time to understand the types of breeding schemes available, you can concentrate on your goals towards producing a healthy and worthy representative of your breed.

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