



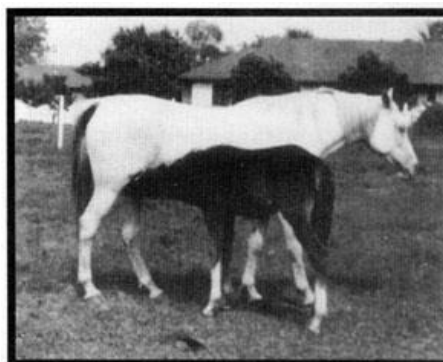
## Questioning Breeding Myths in Light of Genetics

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**"Breeders cannot change Mendelian genetics, nor the number of genes involved in traits, nor their linkage relationships. They cannot change the physiological interactions of gene products, but they can hope through selective mating to realize gene combinations that consistently result in high quality stock."**

Newcomers to horse breeding often look for pedigree formulas or hope to emulate a particular breeder's program by using related stock. Unfortunately for novices, the truths of horse breeding are that many successful horse breeding judgments are in equal measure luck and intuition. Horse breeding is not as easy to fit to formulas as breeding for meat or milk production.

Many of the highly valued traits of horses such as breed type or way-of-going are subjectively evaluated in show ring events. Winners may reflect the skills and show ring savvy of the trainer/handler, as much as the innate abilities of the horse. Some breeders can learn to predict to their satisfaction the approximate phenotype to expect from a selected mating because of their years of experience studying horses and their pedigrees, but their skill cannot always be taught to others and may not work with unfamiliar pedigrees.



BINT SAHARA was a legendary producer of champions (this one is ROYAL GREY). What was her secret? Pedigree? Genes? A magic nick? Some of the above with a touch of just plain luck? (Photo: Linda Sale-Paich)

### Nicks

Horses considered to be of excellent quality often present a pattern of recurring pedigree elements. Breeders naturally seek to define pedigree formulas or "nicks" to design matings that will consistently replicate this quality. But breeding horses is not like following a recipe to make a cake. You cannot precisely measure or direct the ingredients (genes) of the pedigree mixture as you can the flour, sugar, chocolate, eggs and baking powder for a cake. You can construct pedigrees to look very similar on paper, but the individuals described by those pedigrees may be phenotypically (and genetically) quite different. Before seriously considering any breeding formula scheme it is essential that breeders understand the most basic lesson of genetics: each mating will produce a genetically different individual with a new combination of genes.

A certain nick is often expressed as cross of stallion A with stallion B -- an obvious impossibility! Probably one source of this convention is that it is easier to become familiar with the characteristics of the offspring of stallions than mares because they usually have a greater number of foals. Another

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source is the perceived need to reduce complex pedigrees to an easily described summary. Breeding stallion A to daughters of stallion B (this would be the genetically correct description of some nick) may produce horses of a relatively consistent type compared with the rest of the breed. For mares of the next generation, the "magic" nick (stallion C) is again at the mercy of genetic mechanisms that assure genes are constantly reassorted with every individual and every generation. Some breeders are reluctant to introduce stallion C at all, preferring to continue with their A-B horses, breeding their A-B mares to A-B stallions. If a nick works, and it can appear to do so for some breeders, basic understanding of genetics tells us that it is seldom a long term, multi-generational proposition unless it is guided by an astute breeder that is making breeding decisions on individual characteristics, not merely the paper pedigrees.

## **Basing a program on champions**

Novice breeders are often counseled to "start with a good mare." This seems to be reasonable advice, but does not make it clear that the critical point is to learn to recognize a good mare. Sometimes breeders fail to produce a foal that matches the quality of its excellent dam, while less impressive mares in other programs produce successfully. Probably the lack of objective criteria to evaluate horses accounts for both observations. A "good mare" need not be a champion, and a champion is not guaranteed by dint of show ribbons to be a "good mare." As well, we do not know the inheritance patterns of highly valued traits for show ring excellence. If the ideal type is generated by heterozygosity (for example, the ever useful example of palomino), the only infallible way to produce foals that meet the criterion of excellence (palomino color) is to use parents of less desirable type (chestnuts bred to cremellos). This example is not to be taken as a general license to use horses of inferior quality, but to provoke critical thinking about the adequacy of general breeding formulas to guide specific programs. Other breeders pride themselves in structuring programs based on using exceptional stallions. However, breeders should be aware of the fallacy of this type of strategy: "I like stallion Y but I can't afford the risk to breed my mare to an unknown stallion like Y -- I can only breed to a National Champion like Z." Any breeding is at risk to produce a less than perfect foal, but the advertising hyperbole leads novices to think that certain avenues are practically foolproof. Included in the best thought out breeding plans must be an appreciation of the ever-present potential of deleterious genes being included with those highly prized. It is irresponsible to assume that an animal is without undesirable genes. The wise breeder understands the task as minimizing the risk of creating a foal with serious defects and maximizing the chances of producing an example of excellence.

A master breeder needs several generations (generation interval of horses is estimated to be 9-11 years) to create a pool of stock that contains the genetic elements that he or she considers important for the program vision. To learn to identify essential characteristics, a breeder needs to evaluate the horses and their pedigrees, not advertisements or pictures. When a breeder discovers those elements, he or she can make empirical judgments and is on obvious path for making good breeding decisions.

## **The cult of the dominant sire**

In some circles, the highest praise of a breeding stallion is that he is a dominant sire. Another widely encountered livestock breeding term for an elite sire is prepotency. The implication is that all his foals are stamped with his likeness, regardless of what mare is used. This concept would appear to

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contradict the advice "start with a good mare." Those owners who strongly believe in the strengths and qualities of their breeding females would surely question the value of a so-called dominant sire who could seemingly obliterate valued characteristics that would be contributed by their mares. A good understanding of genetics should allow a breeder to put the proper frame of reference to terms such as dominance and prepotency as applied to breeding horses. Some animals transmit certain characteristics at a higher frequency than is generally encountered with other breeding animals. Coat color is always the conspicuous example. Any stallion whose offspring always or nearly always match his color is popularly described as a dominant sire. To be excruciatingly correct, for at least some of the effects being considered the genetic interaction is not dominance but epistasis and homozygosity. A stallion could be homozygous for gray, leopard spotting or tobiano, so that every foal, regardless of the color of the mare (with the possible exception of white), would have those traits. Homozygosity for color is not necessarily linked with transmission of genes for good hoof structure, bone alignment in front legs, shoulder angulation or other traits that may be desirable. Most conformation traits seem to be influenced by more than one gene. Some stallions may be exceptionally consistent sires of good conformational qualities, but it is unlikely that every foal will have these traits or that any stallion could be so characterized for more than a few traits. The balanced view is that a battery of stallions is needed to meet the particular genetic requirements of each of the various mares in the breed. No one stallion can be the perfect sire for every mare's foal.

### **Using genetics to guide a program**

If assays for genes important for program goals are available, the probability of obtaining foals with selected traits from specific breeding pairs can be predicted. For many horse coat colors, offspring colors can be predicted, but conformation and performance traits are not well enough defined for predictive values to be assigned. So little is known about the genetics of desirable traits, it is premature to suggest that any general technique of structuring pedigrees consistently produces either better or worse stock.

The important lessons to learn from genetics to use for horse breeding decisions may seem nebulous to those looking for easy "how-to" information. Yet an appreciation of how genes are inherited, the number of genes involved in the makeup of a horse, their variability within a breed and the inevitability of genetic trait reassortment with every individual in every generation will provide the critical foundation for sound breeding decisions.

With the current interest in genetics and the new technologies available for looking at genes at the molecular level, information about inherited traits of horses is likely to increase significantly in the next decade. Horse owners can help with the process in several ways, including communication with granting agencies about specific problems of interest to them, providing money to fund the research, and providing information and tissue samples to funded research studies. Horse breeders are eager to have sound genetic information and diagnostic tests to guide their programs and fortunately, the future looks very promising.

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