

## Colors and Patterns for the Paso Fino Horse

Paso Fino Horses come in many colors and patterns of white. In this breed horses are allowed to have any color or combination of white markings that are found in normal horse genetics, other than a pattern that is specific to a certain breed (an example would be the patterns found in the Appaloosa Horse--these would not be found in a purebred Paso Fino). Spotted horses in our breed are called pinto, not paint, since the term paint refers to a specific breed of pinto horse, those with Quarter Horse breeding. For breeders of pinto Paso Finos, having an understanding of color genetics is important to be able to create a successful color breeding program.

First it is important to understand general genetic terminology. Colors of the horse, like all other inherited characteristics, are created by pairs of genes which contain the genetic codes which determine the base colors, any dilutions, and any patterns which may be present. For each pair of genes a horse has, one gene came from the sire and one came from the dam. Upper case letters are used to signify a dominant gene and lower case letters are used to signify a recessive gene. Dominant genes are always physically expressed on the horse and at least one parent must have the dominant gene in order to pass it on. Recessive genes are hidden by dominant genes, until two recessives are passed along to the same horse and then the recessives are expressed. If a trait is homozygous, it means that the horse has two identical genes for a certain factor and will pass that gene every time to its offspring. If a trait is heterozygous, then the horse has two different genes (one dominant and one recessive) at a given location and will pass one or the other gene to its offspring in random order.

The two basic coat colors in horses are red (chestnut) and black, with black being the dominant gene. All other coat colors are modifications of these two colors. This location of the genes is called the extension locus and the symbols used are "E" for black and "e" for chestnut. If the horse has "EE" genes, it is homozygous for black and there is no red factor; therefore, this horse can never pass a red recessive gene to any offspring. If the horse has "Ee" genes, it is heterozygous for black color. The physical color of the horse will be black, since black is dominant, but the horse carries the red gene and either gene can be passed along to an offspring. If the horse is "ee" then it has two red genes and will always display the red color. It cannot pass along a black gene to any offspring because it only has red genes. Note that the recessive has to be homozygous in order to be expressed.

One of the major modifiers of coat colors is the Agouti gene. This is the gene that turns a black horse to bay, which is a brown horse with black legs, mane, and tail, and is quite common in the Paso Fino breed. The dominant form is expressed as "A" and a horse that is homozygous for Agouti (AA) will be bay instead of black and will always pass the bay color gene to its offspring. The heterozygous form, "Aa," will still result in a bay horse but this horse will pass along the dominant Agouti gene only half the time. In the homozygous recessive form, "aa," a horse will remain black instead of bay. The Agouti gene has no effect on chestnut horses but can be carried in a dominant form (either AA or Aa) by a chestnut horse. This is why we sometimes see bay offspring resulting from a cross of a black horse with a chestnut horse. The black horse gives the dominant base coat color of black, while the modifier, or the Agouti gene, comes from the chestnut parent and makes the resulting offspring bay instead of black.

Another major coat color modifier is the cream dilution gene. This gene interacts with either chestnut base color or black base color. If a horse has one cream gene and its base color was black, the color result is a smoky black, in which the horse is a faded black color with lighter eyes and some brownish hair in the ears. If a basic black horse has two cream genes, it is a smoky

cream and has blue eyes, pink skin, and a creamy off-white color. If a bay horse gets one cream gene it becomes buckskin which is yellow with black points, and if it gets two cream genes it becomes perlino, which looks very similar to the smoky cream. If a chestnut color horse gets one cream gene, it becomes palomino, or with two cream genes it becomes a cremello. The colors smoky cream, perlino, and cremello would be hard to tell apart and may only be defined by color gene testing. The gene code for the cream gene is listed as "Cr" in current literature.

There are other major genes which can have dominant interactions on the basic coat colors. The dun gene is a dominant gene which can lighten any coat color and add the standard dun markings, which include horizontal stripes on the gaskins and forearms, dorsal stripes, and other striping on the withers and head. Any color can be turned into a dun and colors are referred to as grulla (black dun), red dun, yellow dun, and so on, giving the base color before the dun to indicate the presence of dun markings. The roan gene is a modifier that is also dominant and creates an overlay of white hair on the body of a horse while the head, legs, and mane and tail retain the base color. A red roan would be a chestnut horse with the roan modifiers, a black roan (sometimes called a blue roan) is a black with the roan gene, and so on. Roan horses do not change over time but keep the same amount of white hairs year after year. The gray gene is also a modifier and a dominant gene. Any color can turn gray, in which white hairs gradually take over the existing color so that the horse eventually is white all over. The dun, roan, and gray genes all must be passed on from at least one parent who has the genes, as is the case for any dominant gene. Any of these genes can appear at the same time in a single horse, since they are from different loci, or locations on the genetic code. A horse having many different color variations could produce a variety of genes in its offspring.

The pinto color is actually a pattern of white spotting that is superimposed upon a base color. The pinto gene is another dominant gene that can be inherited independently of these other colors. There are two pinto patterns which can be found in Paso Finos--sabino and tobiano. A sabino horse has jagged white patches with irregular edges on the legs, sometimes with spears of white extending towards the body. Usually there is lots of white on the face and lower lip and white on the underbelly. They may have odd white patches on the knees or hocks plus other roaning areas. Sabinos usually do not have major body spots. The most common pinto pattern is called tobiano. A tobiano pinto has some pattern of white laid over a base color. The base color could be any combination of those mentioned above. The white markings can vary from very little (minimal), such as some white on the legs and a body spot or two, to quite extensive, where the horse is almost entirely white. Tobianos typically have white legs and a solid head with normal horse markings (star, snip, blaze, etc) that may be present. Usually the white spots look like they are arranged from top to bottom on the horse and cross the topline of the horse at some point. The code for tobiano is given as "T" for the dominant and "t" for recessive (some labs or books use the letter "n" for the recessive or non-tobiano), with "TT" being the symbol for homozygous dominant manifesting the pinto color.

In breeding pintos it is helpful to know if a horse is homozygous or not. If a horse is homozygous for tobiano, it will always pass along one tobiano gene to its offspring and therefore all offspring will show the pinto pattern in some amount. If a breeder wants to improve certain characteristics in his/her pinto herd, this can be done by breeding homozygous mares or stallions to quality solid-colored horses who have the desired characteristics. Breeding a pinto who is not homozygous, which would have the genetic code "Tt" for tobiano in the heterozygous state, to a solid mate would result in approximately 50% pinto offspring. Breeding for quality is never a mistake, but some breeders may be frustrated if they do not produce the desired pinto babies. Some pinto breeders use Tt x Tt pintos in crosses which should result in pinto offspring 75% of the time. The only sure way to guarantee a pinto foal is to use a homozygous pinto as at least one

parent in a mating. Because the pinto gene is dominant, it will always be expressed if it is present. Therefore, if the pinto gene is not present, the horse will be some solid color and solid color horses can never produce the tobiano pinto trait, even if one or both of their parents was pinto.

A horse can be homozygous for several different traits at once. For example, a horse could be homozygous for the tobiano gene, in which case it will always produce pintos, and at the same time be homozygous for the Agouti gene, in which case it will always produce bays and therefore bay pintos as opposed to black pintos. If this horse also carries the chestnut color as recessive or is chestnut in its base color, it could produce chestnut pintos when bred to another chestnut or chestnut pinto horse, but will still pass along one Agouti gene to its offspring. It is possible to have a good idea of the genetic makeup, or genotype, of a horse just by studying its own color and that of its parents and offspring. Fortunately there are genetic tests available that use DNA samples from hair roots to analyze for the tobiano, extension (red), Agouti, cream, and sabino genes. These tests will help a breeder know which crosses to make to either create or avoid certain colors in horses. Knowing that a horse is homozygous for tobiano will make that horse more valuable and useful in breeding. Breeders can choose to geld colts, for example, that are not homozygous if they have their foal crops routinely tested, or can place a higher value on a homozygous pinto versus a heterozygous pinto. Since a pinto horse has to receive a pinto gene from each parent in order to be homozygous, it is not necessary to test pintos that have only one pinto parent since these can never be homozygous.

What color a pinto horse turns out to be under the spots is determined by the normal coat color genetics discussed above. If a breeder wants to produce chestnut pintos, for example, he/she would need to use mostly chestnut or chestnut pinto horses, or horses known to carry the chestnut color (either by testing, or a horse who has a chestnut parent, or a horse who has produced a chestnut offspring). If a breeder wanted to breed for palomino pintos, he/she would need to use some horse with the cream gene (either a solid or pinto), which creates the light body color, crossed with a chestnut or chestnut pinto. It is possible to have many variations in color with the pinto spotting pattern added. One caution to pinto breeders is to never cross a pinto with a gray horse. Since both patterns are dominant, it is possible to get a pinto that then turns gray, so the pinto color will become less visible with time and therefore defeats the purpose of having the pinto color in the first place.

We are routinely testing all of our pinto breeding stock and offspring to better know what the genetic color makeup is for the pinto patterns as well as the base colors. We are using Animal Genetics, Inc, from Tallahassee, FL, which uses DNA tests from hair follicles to test for the color genes. They can be contacted at 1-866-922-6436 or at [www.horsetesting.com](http://www.horsetesting.com) for more information. There are many good reference books available that are devoted exclusively to equine color genetics. These can be purchased through large booksellers or through tack catalogs that have book sections. We would encourage a thorough knowledge of color genetics, especially for those owners wishing to raise pinto foals.

Pintos are unique individuals because each one is a little different than the next. There is no guarantee of how much or how little white a pinto will have. Some homozygous or heterozygous horses have minimal markings and some are mostly white. These variations, coupled with a variety of base color possibilities, create an interesting array of pinto Paso Finos. The combinations are endless and are all allowed in the Paso Fino breed.