

Basic Color Testing Defined for the Layman Using Typical Color Variations of the Gypsy Horse

By Priscilla Cox

The basic coat colors of chestnut, bay, brown and black horses are controlled by the interaction between two genes: Extension (gene symbol E) and Agouti (gene symbol A).

The Extension gene (red factor) controls the production of red and black pigment.

Agouti controls the distribution of black pigment either to a points pattern (mane, tail, lower legs, ear rims) or uniformly over the body.

(Note: The effects of other genes may modify these pigments.)

“E” - Red/Black Factor Gene

The Extension locus is a gene related to color and determines whether or not a horse has black “points” as in the bay coat color pattern (the mane, tail, legs and tips of the ears are black). The allele responsible for this pattern is designated as “E”. The capital letter indicates it is dominant. The alternative allele, “e” is recessive, and when a horse has two copies of this allele, as in ee, the horse lacks black pigment in the extremities, as in chestnut horses.

ee	Only the red factor detected. The horse tested homozygous for red pigment. The basic color is chestnut or sorrel unless modified by other color modifying genes.
Ee	Both black and red factors detected. The horse tested heterozygous for the red factor. It can transmit either E or e to its offspring. The basic color of the horse will be black, bay or brown unless modified by other color modifying genes.
EE	Only the black factor detected. The horse tested homozygous for black pigment. It cannot have red foals regardless of the color of the mate. The basic color of the horse will be black, bay or brown unless modified by other color modifying genes.

“A” - Agouti Gene

The A locus can be thought of as the gene that determines if a horse is bay or black, although other genes can come into play. A horse that has at least one dominant "A" allele will be bay if it also possesses at least one "E" allele. A horse that is homozygous recessive for "a", that is "aa", will be black if it also possesses a "E" allele. All black horses are " E/-, aa".

If a horse is homozygous for "e", it will have a sorrel or chestnut base coat regardless of what genes it carries at the A locus. Thus a chestnut horse may be able to produce blacks if it carries an "a" allele and is bred to another horse carrying the "a" allele.

If a person has a black horse and wants to know if a breeding to a chestnut horse will produce a black, the black horse needs to be tested for the E locus and the chestnut horse needs to be tested for the A locus. A black horse that tests homozygous for "a" must also be homozygous for "E" to produce 100% blacks/bays/buckskins.

aa	Only recessive allele detected. Black pigment distributed uniformly. The basic color of the horse will be black in the absence of other color modifying genes.
Aa	Horse tested heterozygous for Agouti. Black pigment distributed in point pattern. The horse can transmit either A or a to its offspring. The basic color of the horse will be bay or brown unless modified by other color modifying genes.
AA	Only dominant allele detected. Black pigment distributed in point pattern. The horse cannot have black foals regardless of the color of the mate. The basic color of the horse will be bay or brown in the absence of other color modifying genes.

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“T” - Tobiano Gene

The tobiano pattern is typically characterized by white across the spine, which extends downward between the ears and tail. A tobiano may be predominately dark or white. The skin under the white spots is pink and under the colored areas is black. The eyes are usually brown, but one or both maybe blue or a mixture of blue and brown. The head is dark with white markings like those of a solid color horse, e.g. star, strip, snip, blaze, etc. All four legs are usually white below the hocks and knees. The mane and tail may be two colors.

Since the tobiano color pattern is valued and is dominant (requires only one parent to carry & pass on the gene), horses that are homozygous (possess two copies of the gene) are of special value to breeders, as ALL their offspring will inherit the tobiano color pattern.

TT	The genetic markers tested indicate the horse is homozygous for Tobiano. The horse should pass on the Tobiano gene to all offspring.
nT	The genetic markers tested indicate the horse is heterozygous for Tobiano and carries one copy of the Tobiano gene.
nn	No genetic markers associated with the Tobiano coat pattern were detected

Homozygous Prediction Table

		SIRE		
		TT	nT	nn
D A M	TT	100% TT	50% TT 50% nT	100% nT
	nT	50% TT 50% nT	25% TT 50% nT 25% nn	50% nT 50% nn
	nn	100% nT	50% nT 50% nn	100% nn

“Cr” - Cream (Dilution) Gene

The cream gene, designated Cr, is a dominant (requires only one parent to carry & pass on the gene) dilution gene that causes a reduction in red pigment in the body hair, mane and tail. It acts on any base color. A true black horses can mask the presence of the Cr gene, so it is possible for a black horse to produce palominos or buckskins. Owners of a black horse with a palomino or buckskin parent may want to determine if the horse carries an unexpressed Cr allele.

CrCr	Double dilute. Horse tested homozygous for Cream Dilution (Two copies of the Cream allele). Chestnut is diluted to cremello, bay is diluted to perlino and black is diluted to smoky cream. These colors can be further modified by the actions of other genes.
nCr	Dilute. Horse tested heterozygous for Cream Dilution (One copy of the Cream allele). Chestnut is diluted to palomino; bay is diluted to buckskin and black is diluted to smoky black. These colors can be further modified by the actions of other genes.
nn	Non-dilute. Horse tested negative for Cream Dilution. Basic colors are chestnut, bay, black or brown in the absence of other modifying genes.

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“Z” - Silver (Dilution) Gene

The Silver gene, designated Z, is a dominant (requires only one parent to carry & pass on the gene) dilution gene that causes an alteration only in black pigment and has no effect on red pigment. Dilution by the Silver gene on a Black horse typically involves lightening of the mane and tail and a dilution of the body to a chocolate color, often dappled as well. A Bay horse carrying the Silver gene will usually have a lightened mane and tail, as well as lightened lower legs. Note: Although a red horse will not be diluted by the Silver gene, it can however be a carrier of the gene and thus potentially pass the gene on to its offspring.

ZZ	Horse tested Homozygous for Silver Dilution (Two copies of the Silver allele detected). Black-based horses will have a chocolate body with flaxen mane and tail. Bay-based horses will have lightened lower legs and flaxen mane and tail.
nZ	Horse tested Heterozygous for Silver Dilution (One copy of the Silver allele detected). Black-based horses will have a chocolate body with flaxen mane and tail. Bay-based horses will have lightened lower legs and flaxen mane and tail.
nn	Horse tested negative for Silver Dilution.