

# GENE FREQUENCY OF THE CREAM DILUTION GENE IN THE MORGAN

BY LORETTA BROWN

Last year we looked at the frequency of the chestnut gene in the Morgan gene pool and how it seemed to change over the years, increasing and then approaching back toward original levels.

This year we will look at the frequency of the cream dilution gene (Cr) in the present day Morgan.

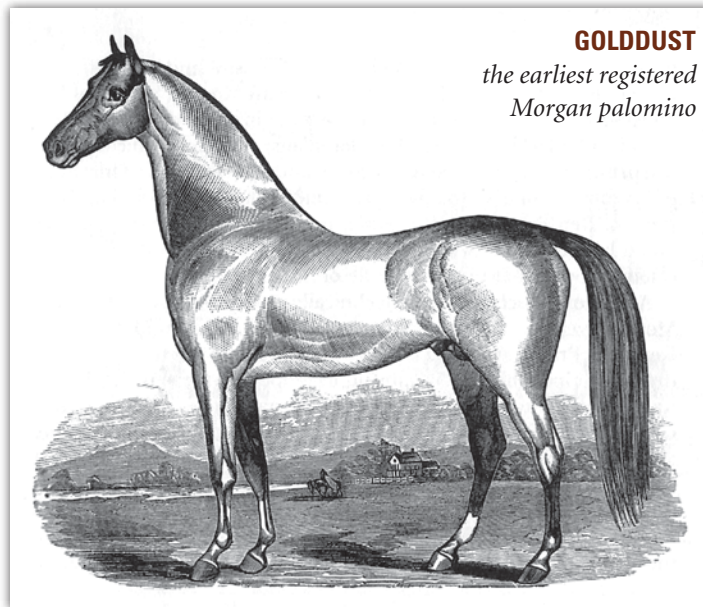
For a short review, let's look at the action of the cream dilution gene as relates to the base colors of chestnut, bay, black and brown. A single dose of the cream dilution gene will act on chestnut to produce palomino, on bay to produce buckskin, on black to produce smoky black and on brown to produce smoky black with just dilution areas possibly noted around the muzzle and flank (where a brown horse is brown).

A double dose of the cream dilution gene will act on chestnut to produce cremello, on bay to produce perlino, and on black or brown to produce smoky cream.

The cream dilution gene has been present in the Morgan since the early history of the breed. One of the earliest is noted in Volume One of the Morgan registry and is a grandson of Figure/Justin Morgan. He was called Buckskin 41 or Buckskin Wheeler Horse. There were also others identified in the years before 1900 as buckskin (4) and palomino (2). The lowest registration number for a palomino is for Golddust 70.

There were also two horses called dun. The lowest dun was # 724 called Blue Ned. A true dun is not caused by the action

of the cream dilution gene but by another dilution gene. And with a name like Blue Ned, he may have been a true dun indeed. Unfortunately, sometimes buckskins were called duns when they were registered and it is difficult to know for sure if the dun was really a dun or buckskin. Examining the history behind the horses, as well as progeny could help. We are so lucky, now, to be able to gene type our Morgans and find out if they carry the cream dilution gene or some other.



**GOLDDUST**  
*the earliest registered  
Morgan palomino*

Now, let's get back to the frequency of the cream gene in our current day Morgans. There are only 2 known alleles of the cream dilution gene. They are the "normal" allele—"C"—which has no dilution effect and "Ccr" which causes dilutions. UC Davis uses the "N" to signify the "normal" allele and "Cr" to signify the dilution allele. In order to determine the frequency of an allele in this two allele system it is best to find the number represented by the double dilution for the Cr allele. These double dilutes are the ones that will most readily and correctly be identified. The

single dilutes might possibly be misregistered as their base color rather than a dilution. Once one has figured out the frequency of the Cr allele, then mathematically, it is easiest to figure out the frequency of the other.

In our Morgans, horses with two doses of the cream dilution gene would be represented by cremello, perlino, and smoky cream. Unfortunately, these colors have only become available for our use on registration forms since 2006. Before that, all these double



The cremello, **GOLDTREE STARLITE EXPRESS**  
(Carrollton x Goldtree Athena) (Photo © Howard Schatzberg)

**ACTION OF THE CREAM DILUTION GENE (Cr)  
AS IT RELATES TO BASE COLORS**

COLOR	CREAM DILUTION GENE—Single Dose	Double Dose
chestnut	palomino	cremello
bay	buckskin	perlino
black	smoky black	smoky cream
brown	smoky black*	smoky cream

\*with dilution areas possibly noted around the muzzle and flank  
(where a brown horse is brown)

dilutes were grouped under “crème” which was added to the color selections in 1996—the same year the “high white rule” was rescinded. Before that these horses may not have been registered at all or registered as some other color. In the past, (before the white rule which was introduced in 1964) there were Morgans registered as “white.” Some of these were, undoubtedly double dilutes. Because of this, we can only look at the most recent statistics to try and determine the frequency of the cream dilution gene in the Morgan population.

Using the same data that was provided to me last year and then for 2010, I was able to look at the number of double dilutions for the years 2000-2010—an 11 year span.

During that time there were 103 crème, 74 cremello, 45 perlino and 11 smoky creams for a total of 233 double dilutes out of 29,661 horses. This gives us about 0.8% of double dilutes. This means a 0.008 frequency for CrCr or a 0.09 frequency (remember square root) (rounded to the nearest hundredths) for the Cr allele. Remembering our equations from last year, the two alleles have to add up to 1. So the “normal” allele frequency is 1-0.09 or 0.91.

One assumes that the double dilutes are most easily and correctly identifiable without actual gene testing—by their actual color and by their pedigree.

Remembering the equation  $a^2 + 2ab + b^2 = 1$ , we can calculate the percent of Morgans carrying the cream dilution gene. Remember from above the value for Cr is 0.09 and, therefore, the “C” or “N” will be 0.91. “a” represents N or C and “b” will represent Cr.  $a^2$  represents those horses without any cream dilution gene;  $2ab$  represents those with 1 copy of the dilution gene and  $b^2$  represents those with 2 copies of the cream dilution gene. Doing the math, we find that about 0.17 or 17% of Morgans from 2000-2010 carry the cream dilution gene. Conversely, 0.83 or 83 % do not.

If one looks at the numbers from 2010 alone, there were 207 buckskin, palomino and smoky black registered (these represent the single dilutes—“2ab”) and 24 double dilutes for a total of 231 out of 1887 registrations. If one uses the gene frequency for Cr, there should have been about 321 horses registered that were either single or double dilutes. We can be pretty certain of the number of double dilutes as they are more easily identified without being gene typed. So this means that there may be about 90 horses that were registered as black, bay, brown, or chestnut that could carry the cream dilution gene and could really be either buckskin, smoky black or palomino.

The best statistics for any color genetic research would be obtained if all horses were gene typed for color. However, this is not required by the registry and, therefore, it limits precision of the data. Using the double dilutes, however, can give one a good approximation of the frequency of this cream gene in the Morgan gene pool for horses registered since 2000.

We will see what the future holds and if the frequency of the cream gene changes over the coming years.

My thanks to Erica Richards for providing the numbers and dates used in this short research piece. ■

Loretta Brown’s last Breed Research article, “Gene Frequency of Chestnut Base Coat Color,” appeared in the March 2010 issue, page 46.