Cardigan Welsh Corgi Coat Color Genetics

a report to the Cardigan Welsh Corgi Club of America

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Introduction

Over the past year, Sue Buxton, as the Health Representative for the Cardigan Welsh Corgi Club of America, has helped contact dog owners for a study of coat color in this breed. Several individuals have contributed DNA cheek brush samples and photos of their dogs and we appreciate this very much. A few have also contributed whole litters. Although the study is not complete in the sense that the genes for all patterns and colors have not been found, we have made some progress and this report will explain the status of our findings to date.

The E locus

Melanocortin Receptor 1 (MC1R) is the gene at the E locus. Dogs have 3 alleles at this locus: E^M, E, and e. All three occur in Cardigans.

Pepper, above, is E/E at this locus. Most people would call Pepper "red" but she is a reddish color because she has an a^y allele. She has no melanistic mask.

Honey, on the right and Maizey, on the left, are both E^M/E. Athough the E^M allele is dominant, Honey does not show a melanistic mask though either! Since most Cardigans have

the characteristic white undersides, necklace and muzzle…..the melanistic mask doesn't show. This is proof that the white is caused by a loss of pigmentation, as is typical of most forms of white. Maizey has a hint of a mask on her cheek. Other modifier genes cause the difference in the tone of red or the relative amount of black hairs in the red coat as demonstrated by Honey and Maizey. Some breeders thought that the darkness of a dog like Maizey meant she was a^y/a^t, but actually so is Honey and Pepper!

Sassy, on the left, has an e/e genotype at this locus and is a “clear red”. She also has a brown nose but that is caused by another locus, the B locus. The e allele appears to be much less common than the E or E^M alleles. The shade of red appears to be paler in Sassy than the others but we have not examined enough dogs nor seen enough photos to be sure of this. Apparently these pups are noticeably paler as young pups as shown by the two pups at the right.

Dogs of e/e genotype could carry brindle and/or merle and not exhibit these patterns. That is because such dogs are unable to make black pigmented hairs anywhere on their body. Likewise this genotype is also epistatic to tricolor (a^t/a^t).

Agouti Locus

There are 2 A alleles at the agouti locus in Cardigan Welsh Corgi (a^y and a^t) which cause the two main underlying coat color patterns: sable-and-white (left) and tricolor (right). Note that color terminology in Corgis, can be a bit confusing in comparison to some other breeds. Sable and red and fawn have been used as different terms for dogs of the same agouti genotype. The a^y allele is dominant to the a^t allele. Neither the a^w (wild type banded hairs as in wolves) nor the a (recessive black) have been found in this breed.

Although Cardigans are often called "black", solid black or black and white are not colors in this breed. The Cardigans called black are all tricolor dogs with black on the dorsal area and white on the ventral area and a bit of tan in between.

Merle

Each of these agouti colors (sable and black-and-tan) may occur with or without Merle. At the present time there is no DNA test for Merle, but since the merle pattern is exhibited by the Mm heterozygotes, the phenotype is predictive of the genotype. Note that MM dogs are primarily white and conscientious breeders avoid producing such dogs since deafness is typical and eye defects are also common.

Christy, above, is a merle female with tan points. Therefore she is a^t/a^t at the agouti locus. The merle pattern never shows swirling or black on the tan points. Both a^t/a^t and $a^y/-$ dogs do not show merle on their white undersides either.

Brindle

Each of these agouti colors may also occur with or without brindle. Corgis that have at least one a^y allele like Belle on the left, will be brindle over most of the body , except on the white ventral surfaces. Cardigans that are a^t/a^t like the dog on the right, will have brindle only on their "points", i.e. they will be brindle where they would otherwise have had tan. At the present time, DNA testing is not yet available to detect the brindle allele.

Brown

Brown occasionally occurs in Cardigans. This is due to a b/b genotype at the B locus. The gene at the B locus is *Tyrosinase Receptor 1 (TYRP1)*. Dogs that are red or sable such as Sassy near the top, can have a brown nose if they have a b/b genotype. At least one B allele is needed for black nose leather.

Dogs that are a^t/a^t will be brown tricolors, instead of being black-and-tan-and-white. The brown can be difficult to distinguish from the tan in some dogs which have very tiny amounts of tan. Dogs that are b/b may also be merle but the merle will not include any black hairs, just darker and paler brown regions. Likewise dogs with a b/b genotype that are brindle will have brown stripes instead of black stripes.

The alleles at the A and E locus were identified by a collaborative research project between the labs of Dr. Greg Barsh at Stanford University and the Dr. Sheila Schmutz at the University of Saskatchewan, who also identified the B locus alleles. They also have a collaborative project in which they have mapped the chromsomal region containing the brindle gene and are now trying to isolate the gene and its alleles. Many dog owners helped by contributing either individual samples or samples from complete litters.

Genotypes	Coat Color	Nose Color	Hidden Color
E^M/E^M, B/B, a^y/a^y	Sable with mask	black	none
E^M/E, B/B, a^y/a^y	Sable with mask	black	lack of mask
E^M/E^M, B/b, a^y/a^y	Sable with mask	black	chocolate
E^M/E, B/b, a^y/a^y	Sable with mask	black	lack of mask, chocolate
E/E, B/B, a^y/a^y	Sable without mask	black	none
E/E, B/b, a^y/a^y	Sable without mask	black	chocolate
E/E, b/b, a^y/a^y	Sable without mask	brown	chocolate
E^M/E^M, b/b, a^y/a^y	Sable with mask	brown	chocolate
E^M/E, b/b, a^y/a^y	Sable wth mask	brown	lack of mask, chocolate
E^M/E^M, B/B, a^y/a^t	Sable with mask	black	tan points
E^M/E, B/B, a^y/a^t	Sable with mask	black	lack of mask, tan points
E^M/E^M, B/b, a^y/a^t	Sable with mask	black	chocolate, tan points
E^M/E, B/b, a^y/a^t	Sable with mask	black	lack of mask, chocolate, tan points
E/E, B/B, a^y/a^t	Sable without mask	black	sable, tan points
E/E, B/b, a^y/a^t	Sable without mask	black	sable, chocolate, tan points
E/E, b/b, a^y/a^t	Sable without mask	brown	sable, chocolate, tan points
E^M/E^M, b/b, a^y/a^t	Sable with mask	brown	chocolate, tan points
E^M/E, b/b, a^y/a^t	Sable wth mask	brown	lack of mask, tan points
E^M/E^M, B/B, a^t/a^t	black-and-tan with mask	black	none
E^M/E, B/B, a^t/a^t	black-and-tan with mask	black	lack of mask
E^M/E^M, B/b, a^t/a^t	black-and-tan with mask	black	chocolate
E^M/E, B/b, a^t/a^t	black-and-tan with mask	black	lack of mask, chocolate
E/E, B/B, a^t/a^t	black-and-tan	black	none
E/E, B/b, a^t/a^t	black-and-tan	black	chocolate
E/E, b/b, a^t/a^t	black-and-tan	brown	chocolate
E^M/E^M, b/b, a^t/a^t	chocolate-and-tan with mask	brown	none
E^M/E, b/b, a^t/a^t	chocolate-and-tan with mask	brown	lack of mask
e/e, B/-, any a alleles	"clear red" to "pink"	black	(brindle, tan points, merle)
e/e, b/b, any a alleles	"clear red" to "pink"	brown	(brindle, tan points, merle)