Colors of Miniature Schnauzer and their inheritance

According to breed standard, Miniature Schnauzer has four accepted colors: solid black, salt and pepper (sp), black and silver (bs) and white. These colors are created mainly by three color loci.

First, a dog either has dark pigment aka eumelanin in its coat, or it doesn't have it. This is controlled by E locus. If dark pigment is present, the dog is black, sp or bs, and if there no eumelanin in the coat, the dog is white.

Second, if the dog is dark (non white), it is either totally covered by eumelanin pigment and it is solid black, or eumelanin covers just part of the coat and the dog shows a pattern, aka it is patterned. This is controlled by K locus.

Third, when a dog is not black or white, it is patterned, and there are several different possible patterns. Standard accepts just two patterns, sp and bs. There are also sable dogs in the breed, but it is not accepted by standard. A locus controls this. Now, lets look at each of these three loci one by one and see, how they affect coat color.

E locus, dark or white

E locus decides if a dog is white (pale yellow) or dark / other than white. This breed has basically two options here, E aka the normal allele (wild type allele) and e aka recessive yellow allele. Gene pairs E/E and E/e let the dog be "colored" (dark), and e/e gives white. In most other breeds e/e dogs show some shade of yellow / red, but in all Schnauzers e/e dogs are nearly always white, either pure white or white with cream shading.

When a Schnauzer is e/e, it is always white, and other loci explained here have no effect on coat color, because e/e pair prevents eumelanin pigment from entering growing hairs and only yellow / pale pigment, pheomelanin, can enter them. In Schnauzers pheomelanin is normally so pale that it looks white, and that's why dogs, which are genetically recessive yellows are called white in this breed.

As they are actually super pale yellows and not "true" whites like extreme white spotted breeds (like Dogo Argentino) or extreme double merles (like white Great Danes), they have no health issues linked to color. When a dog has extreme amount of true white on head, it can be deaf and is a white dog has sparse or very short coat, its pink skin can sunburn. It is safe to be white due to e/e, like Mini Schnauzers are.

Some Mini Schnauzer populations have also the E^m allele in their E locus, and it is dominant to both E and e alleles. It creates a dark mask on the muzzle of a patterned dog. It doesn't affect blacks or whites at all, but can turn the faces of sp and bs dogs too dark.

K locus, black or patterned

This breed has also just two options in this locus, K^B and k^y. The recessive k^y allele is the normal aka wild type allele and the dominant mutation K^B allele is called dominant black. If a dog is K^B/K^B or K^B/k^y it is solid black. If it is k^y/k^y, it has both black and pale hairs in its coat, and can show its A locus pattern aka agouti locus pattern, aka the dog is patterned. But if a dog is e/e, it doesn't matter what it has in its K locus, as it is white anyway.

When a dog is K^B/K^B or K^B/k^y, it is normally just proper, solid black. But some K^B/K^B and especially some K^B/k^y dogs are not deep, jet black to roots but seal colored. In that case a hint of the underlying A locus pattern can be seen "through" the eumelanin overlay. If the pattern is salt and pepper, all of the under parts of the dog show some pale shading, sometimes sides too and such a dog is called seal. If the hidden pattern is black and silver, just the point areas show pale shading and such a dog can be called ghost tanpoint. Pale coat areas are never true pale, but covered by dark overlay everywhere, except sometimes on butt.

A locus, agouti patterns

Mini Schnauzers have three options in this locus: a^w agouti (also called as wolf pattern, wild boar, wild pattern or wolf sable), a^t tanpoint (also called as black and tan) and a^y sable (also called fawn), and that last one isn't accepted by breed standard.

Allele pairs a^w/a^w and a^w/a^t give agouti pattern, which is called "salt and pepper" in this breed, and a^t/a^t gives tanpoint pattern, which is called "black and silver". Combinations a^y/a^y, a^y/a^w and a^y/a^t all give sable pattern. Except if the dog is e/e, in which case it is white, or if it is $K^B/-$, in which case it is black (unless it is also e/e and so white). Genotype a^w/a^w gives normally the ideal type of sp pattern. a^w/a^t is also sp, but it is on average darker and can in some cases be too dark for show ring. a^t/a^t is always black and silver.

a^y/a^y, a^y/a^w and a^y/a^t are sables. a^y/a^y type sable is on average palest, with least shading (black hairs in the coat). a^y/a^w and a^y/a^t are on average darker, with more black shading mainly on backside. A sable Miniature Schnauzer is most often clearly cream or wheaten colored, and so you can see it is not a white dog even when it doesn't have any black shading. When a sable pup is newborn, it can look nearly identical to a salt and pepper pup, although it has on average paler backside even as a young pup.

It has been recently proven that Mini Schnauzers have also recessive black, which comes from the most recessive allele of A locus, a. You normally can't tell a recessive black dog (a/a k^y/k^y) apart from a dominant black dog ($K^B/-$) by looks. A gene test can tell the difference, and sometimes also the colors of parents: If two black and silver or salt and pepper dogs get a solid black pup (which stays all black when it grows), it can't be a dominant black as due to parents, it can't have the K^B allele. Such a pup must be a recessive black.

When combined with other A locus alleles the a allele will make the dog look slightly and sometimes even clearly darker than normal dog. An a^w/a dog is still salt and pepper, but it can be really dark with smutty looking pale coat areas. a^t/a is black and silver, but pale points are on average smaller than in a^t/a^t type dogs.

The dominance order of A locus alleles

a^y sable
a^w salt and pepper (agouti)
a^t black and silver (tanpoint)
a recessive black (recessive solid dark)

List of genotypes and phenotypes

Here is a list of all possible combinations of basic alleles and their phenotypes in Miniature Schnauzers. Mask E^m and recessive black a have been left out, but sable is included.

First there is a list of all possible white genotypes. When a dog has e/e in its E locus, it doesn't matter what it has in A and K loci, as it is white anyway.

a^y/a^y K^B/K^B e/e
a^y/a^y K^B/k^y e/e
a^y/a^y k^y/k^y e/e
a^y/a^w K^B/K^B e/e
a^y/a^w K^B/k^y e/e
a^y/a^w k^y/k^y e/e
a^y/a^t K^B/K^B e/e
a^y/a^t K^B/k^y e/e
a^y/a^t k^y/k^y e/e
a^w/a^w K^B/K^B e/e
a^w/a^w K^B/k^y e/e
a^w/a^w k^y/k^y e/e
a^w/a^t K^B/K^B e/e
a^w/a^t K^B/k^y e/e
a^w/a^t k^y/k^y e/e
a^t/a^t K^B/K^B e/e
a^t/a^t K^B/k^y e/e
a^t/a^t k^y/k^y e/e

Next there is a list of all possible genotypes which give black. A locus doesn't matter, there has to be at least one K^B in K locus and E locus has to be anything else but e/e.

a^y/a^y K^B/K^B E/E
a^y/a^y K^B/K^B E/e
a^y/a^y K^B/k^y E/E

a^y/a^y K^B/k^y E/e
a^y/a^w K^B/K^B E/E
a^y/a^w K^B/K^B E/e
a^y/a^w K^B/k^y E/E
a^y/a^w K^B/k^y E/e
a^y/a^t K^B/K^B E/E
a^y/a^t K^B/K^B E/e
a^y/a^t K^B/k^y E/E
a^y/a^t K^B/k^y E/e
a^w/a^w K^B/K^B E/E
a^w/a^w K^B/K^B E/e
a^w/a^w K^B/k^y E/E
a^w/a^w K^B/k^y E/e
a^w/a^t K^B/K^B E/E
a^w/a^t K^B/K^B E/e
a^w/a^t K^B/k^y E/E
a^w/a^t K^B/k^y E/e
a^t/a^t K^B/K^B E/E
a^t/a^t K^B/K^B E/e
a^t/a^t K^B/k^y E/E
a^t/a^t K^B/k^y E/e

And this last list shows all patterned phenotypes aka sable, salt and pepper and black and silver. K locus has to be always k^y/k^y, and E locus has to be something else than e/e. A locus controls the visible pattern.

a^y/a^y k^y/k^y E/E sable
a^y/a^y k^y/k^y E/e sable
a^y/a^w k^y/k^y E/E sable
a^y/a^w k^y/k^y E/e sable
a^y/a^t k^y/k^y E/E sable
a^y/a^t k^y/k^y E/e sable

a^w/a^w k^y/k^y E/E salt and pepper
a^w/a^w k^y/k^y E/e salt and pepper
a^w/a^t k^y/k^y E/E salt and pepper, often darker than average
a^w/a^t k^y/k^y E/e salt and pepper, often darker than average

a^t/a^t k^y/k^y E/E black and silver
a^t/a^t k^y/k^y E/e black and silver

And then to other stuff which can affect coat color in this breed.

Grey / silver / fading

Color of the coat of bearded dogs is also affected by "G gene" aka greying / silvering gene. The G gene (or "G type genes", as there could be more than one such gene, and the recently found KITLG gene is quite likely one of them) works only with bearded aka furnished coat type, like Schnauzers have. A hair starts to grow with normal colored tip, but each hair turns paler than average or even white at some point of growth. Individual hairs can change color at different times so that some are dark to the root, some might have just minor dark tip and all the rest is white.

If you cut the hair tips away, resulting coat color is rather even grey, either darkish, medium or pale grey. When coat is rather short (either it is naturally short, or it has been hand stripped to short) and all the hair tips are present, shade of grey is never fully even but a dog looks "peppered", mixture of darker and paler hairs or pale/white hairs can be seen in the middle of darker coat. The G gene affects both eumelanin and pheomelanin. Black turns into grey, dark pheomelanin into some shade of gold and cream can turn white. Greying is dominant to no-greying. "Blue" color seen in many terrier breeds (like all of the coat of Kerry Blue Terrier, or saddle of Yorkshire or Airedale Terrier) is black turned grey by this greying gene.

Strong G type greying is not wanted in Schnauzers, but milder greying is common and stronger greying exists too. For example, non trimmed black Mini Schnauzers are very often some shade of grey instead of jet black when adult, while black Giant Schnauzers stay on average purer black. So, that breed has no or at least far less greying.

G type greying is highly unwanted in blacks and black and silvers. Salt and peppers do not need G type greying, although mild greying normally doesn't matter. Photos show that some American dogs seem to have quite strong greying and so they look on average paler than European ones. But white Mini Schnauzers benefit from strong greying, as it turns possible cream shading paler.

Color of pheomelanin

Patterned and white dogs show their pheomelanin color well, and in this breed it is preferred that pheomelanin is as close to white as possible. But you can't see which shade of pheomelanin a black dog has, and so some blacks might have colored pheomelanin instead of nearly white. When that happens, you can see it only when blacks are crossed with other colors. Darker shades of pheomelanin are on average more dominant than paler shades.

White spotting and white markings

When a dog is black, even tiny white markings are easy to see, but small markings like white toes or a small chest patch are hard to see from sp and bs dogs. When a dog is white, it can have even quite big white markings and you can't see them from pale coat, just pink skin under white spotting reveals them.

As there is no strong selection against minor white spotting in other colors than black, a

black dog from a color cross is slightly more likely to show minor white spotting than a black from pure black pedigree.

There is also a gene for stronger white spotting aka piebald ("parti") pattern, the s^p allele from S locus. Piebald is mainly recessive to solid, and so a totally solid dog or a dog with very minor white can sometimes be a piebald carrier. If you happen to breed two such dogs to each others, you can get visually piebald pups.

Seal and ghost tanpoint

These dogs are genetically dominant black dogs, not patterned dogs although their ghost pattern can sometimes be rather visible. A black dog with long all black pedigree is about always a "proper" black, and a black dog with color crosses in close pedigree is at least slightly more likely to be seal or ghost tanpoint, especially if it also happens to be K^B/k^y and not K^B/K^B.

Smutty pattern, wrong kind of pattern

Traditionally a salt and pepper dog is supposed to show just certain dark/pale pattern in its coat, although in all dogs there is quite a lot of variation inside the phenotype given by a^w agouti pattern. Also tanpoint pattern can vary from huge points to very small and smutty points. A heterozygous a^w/a^t doesn't always count as a "proper" salt and pepper, as it can be quite dark, but not black enough for a proper black and silver.

When you have a black or white dog, you can't see at all what kind of pattern it carries. If you have a salt and pepper dog, you can't see what kind of modifiers for tanpoint (black and silver) pattern it has, and if you have a black and silver dog, you can't see what kind of modifiers for agouti (salt and pepper) pattern it has.

Brown and blue

Normal eumelanin pigment is black. Recessive B locus alleles can turn it into brown (chocolate, liver) and recessive D locus alleles can turn it into blue (dilute). This doesn't have anything to do with crossing standard colors with each others, but these are recessive genes found in some bloodlines of this breed.

A black or other dark dog can show brownish or rusty shade in its coat, if coat is old and ready to be stripped or it is faded due to sun. That is not real brown, but just faded black. In some breeds, like Poodles, a born black but greyed into darkish grey dog is often called "blue", but it is not a real blue.

Merle

Yes, merle seems to be in the breed gene pool nowadays. Merle gene has been imported into the breed by crosses with other breeds. If you still want to work with merle, take care and learn the basics of it thoroughly, as breeding two merles can sometimes produce deaf

and blind pups. You can't see if a white dog is merle or not, and merle pattern can be very hard to see from patterned, but pale coat. "Lesser" aka shorter merle alleles do not give any visual pattern to dark coat either, but when combined with a stronger merle allele, there can be pups with defects. Only way to breed merle dogs responsibly is to know enough about this color gene and properly test all breeding dogs for merle.

About gene tests

There is a reliable test for E locus, and it is easy to test if a dog is E/E or E/e. There is no need to test white dogs for this locus, because they are always e/e. Sometimes the test might tell that a dog has the E^m allele for mask, although it really doesn't show any visual mask, and sometimes a dog, which tests as E/E or E/e has a mask.

There is also a test for K locus, but as brindle allele from this locus isn't testable, that test doesn't work well with breeds which have also brindle. But as Mini Schnauzers are not supposed to have brindle, you can normally trust this test too. There is no need to test a patterned dog, as they are always ky/ky, but if you have a black dog, a test will tell if it is K^B/K^B or K^B/k^y. Also, white dogs can be tested to see if their K locus is K^B/K^B, K^B/k^y or k^y/k^y.

There is also an A locus test, which in theory is supposed to tell if a dog has a^y, a^w or a^t alleles, but due to problems with this test, some clearly tanpoint (black and silver) dogs have tested as "a^w/a^w" although they are not that, and so the test available nowadays isn't always reliable. This locus has been studied deeper recently, and a better test might be available quite soon.

NOTE! The dogs in the drawings are just simplified examples of different phenotypes, and they are not exact replicas of real life looks.