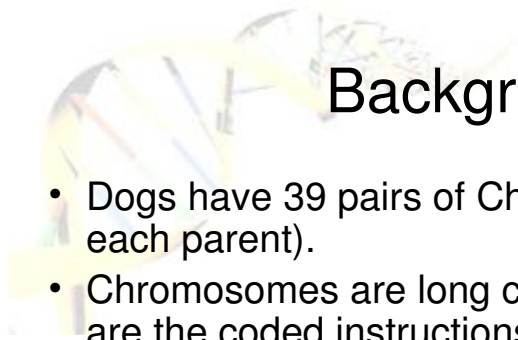


# The Genetics of Dachshund Coats and Colours



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## Background

- Dogs have 39 pairs of Chromosomes (one from each parent).
- Chromosomes are long chains of genes which are the coded instructions for all characteristics, therefore Genes come in pairs too – 1 from each parent.
- Genes control coat colour and coat type.
- Different combinations of these genes gives rise to the multitude of coat types and colours seen in Dachshund today.

# Coat Type in Dachshunds



- 3 coat types – Wire, Smooth and Long.
- Dogs in the UK normally have 2 copies of their own coat type gene (WW, SS or LL) because we do not as a rule currently perform cross-coat matings. However these were allowed until 1977 and there are still wires and smooths that “carry” the genes for different coat types.
- Imported dogs from countries where cross coat matings are more common may have combinations of the coat type genes.
- Wire is dominant to all other coat types, if a dog has even just one W gene it will be a Wire, if it has one of the other coat type genes it can pass that gene on to its progeny and produce “recessive Smooths” or “recessive Longs”.
- Smooth is dominant to Longs, if a dog has one S and one L gene it will be a Smooth, but it carries the Long gene and therefore can pass it on to its progeny and produce “recessive Longs”.
- Long is recessive to both Wire and Smooth, therefore if the dog has a Longhaired Coat it has to have 2 copies of the Long Haired gene (LL); two Longhaired parents can only produce Longhaired puppies.



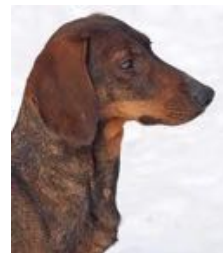
## Recessives

- If a recessive Smooth or Long is produced in a litter it will only have the coat type genes for that coat type.

**Example** – 2 Wirehaired parents produce a Smooth haired puppy  
 Both parents must have one Wire gene and one Smooth gene (WS and WS)  
 When the sperm are produced each one either gets a W gene or a S gene  
 When the eggs are produced each one either gets a W gene or a S gene  
 At fertilisation one sperm and one egg join together, if a sperm with the S gene and an egg with the S gene join together then the puppy will be a Smooth haired.

There is a 25% chance of each puppy being Smooth haired

Genes in gametes	Sperm W	Sperm S
Egg W	WW	WS
Egg S	WS	SS



# Coat Colour

- Colour genetics in Dachshunds is very complicated due to the huge variety of colours/patterns that exist and the large number of genes responsible for it.
- Understanding how these colours/patterns interact can help predict the colour of puppies and also can help to avoid certain problems that are linked to particular colours.
- Knowing what colours are behind your own dogs is vitally important so that certain undesirable colours/patterns/health problems are avoided.
- The following information mainly refers to the colour genes present in Smooths and Longs. Wires and Mini Wires do have some of these genes but, as most are wild boar (sable) in colour, only the relevant bits of the next slides should be applied.

# Colour vs Pattern

**Colour** refers to the basic coat colour

- Red
- Cream
- Black and Tan
- Black and Cream
- Chocolate and Tan
- Chocolate and Cream

**All Dachshunds are one of these 6 basic coat colours**

**Pattern** refers to Dapple/Brindle/Sable or Piebald

- All of these patterns can affect any of the basic colours

## Dilutes and Solids

**Dilutes** – Dachshunds can also have a dilution gene which alters Black to Blue and Chocolate to Isabella – more about dilutes later.

**Solids** – As far as I understand, there are no solid colour Dachshunds in the UK (solid black or solid chocolate), all UK Dachshunds have tan/cream points. Even Red and Cream Dachshunds have tan/cream points, you just can't see them as the points are the same colour as the body coat.

Solids do exist in some countries (mainly America) but there is conflicting information about their true origins.

## Dominant and Recessive Colours

Dachshunds have at least 7 different pairs of genes that control coat colour; there may be more as yet unidentified genes that also have an effect on the colour and/or pattern seen.

In Scientific literature genes are identified by letters (dominant genes by a capital letter, recessive genes by a small letter).

Genes can exist in more than one form, called Alleles, and depending on which alleles your dog inherits from its parents will depend on the colour it is.



## Black & Tan or Chocolate & Tan

Black and Chocolate are controlled by one pair of genes, this pair of genes is recessive to Red and therefore if both parents are Black and Tan or Chocolate and Tan then they cannot produce a red puppy **UNLESS both parents have the "e red gene"**.

**Black and Tan dogs are BB**

**Black and Tan dogs carrying chocolate are Bb**

**Chocolate and Tan dogs are bb**



Examples:

Both parents BB			One parent BB			Both parents Bb		
Genes in Gametes	Sperm B	Sperm B	Genes in Gametes	Sperm B	Sperm b	Genes in Gametes	Sperm B	Sperm b
Egg B	BB	BB	Egg B	BB	Bb	Egg B	BB	Bb
Egg B	BB	BB	Egg B	BB	Bb	Egg b	Bb	bb
100% BB – All Black & Tan			50% BB, 50% Bb			25% BB, 50% Bb, 25% bb		



## Red



Red is a dominant colour. If a Dachshund has even one copy of the Red gene it will be Red no matter what other genes it has; the exception to this is if the dog also has 2 copies of the cream gene in which case it will be cream.

In Scientific literature the red gene seen in Dachshunds is given the letters  $A^y$ .

Dachshunds that have inherited two copies of this gene ( $A^yA^y$ ) are dominant or homozygous red – they can only produce red puppies no matter what they are bred to (they can of course also have one or more of the pattern genes).

Dachshunds that have one copy of the  $A^y$  gene will be red but will be able to produce puppies of different colours (depending on the other genes they also have). Normally these Dachshund possess the  $A^yA^t$  combination.

Two copies of the  $A^t$  version of this gene ( $A^tA^t$ ) will result in dogs with tan points (Black & Tan or Chocolate and Tan).

# A bit about pigment

Nose and nail pigment is affected by the coat colour genes, specifically the genes responsible for Black and Chocolate. All Dachshunds have these genes even if they are dominant red, it's just that they are not expressed.

- If a dog has the BB combination of genes it will have Black pigment
- If a dog has the Bb combination of genes it will have Black pigment
- If a dog has the bb combination of genes it will have brown/liver pigment

Therefore Red dogs that also have the bb combination will be reds with brown noses and nails, this goes against what our breed standard calls for and is the main reason it is not recommended to breed reds to chocolates or to known chocolate carriers.

There are also other factors which affect pigmentation particularly of the nose, including dietary deficiencies, seasonal changes and some immune disorders such as Vitiligo.

## ee Red



- There is evidence that there is another form of Red present in Dachshunds (so far only seen in Mini Longs in the UK).
- Most Dachshunds have the EE version of this gene or occasionally E<sup>m</sup>E<sup>m</sup> (which produces a black mask/black markings on tan points), this has no effect on the A<sup>y</sup>A<sup>y</sup>/A<sup>y</sup>A<sup>t</sup>/A<sup>t</sup>A<sup>t</sup> gene or on the BB/Bb/bb gene.
- Occasionally though Dachshunds have the “ee” version of this gene (this may have been present in the breed since its inception or may have been caused by a mutation more recently).
- This version of the gene masks all other colours and produces a red dog devoid of all black hairs (including whiskers), although they will have black noses and nails (unless they have the bb alleles in which case they will have brown noses and nails).
- This gene can result in producing red puppies from 2 Black and Tan parents. If a red puppy does have 2 Black and Tan parents (or 2 Chocolate and Tan parents, or one of each) then it **MUST** be an “ee red”.



## Cream

Cream is a recessive gene, therefore dogs must inherit one copy of the relevant allele from each parent. All colours of dog can “carry” one copy of the cream allele without showing that colour.

Most Dachshunds are  $C^{ch}C^{ch}$ , i.e. they are not cream and do not carry cream.

The Cream colour is mainly seen in Mini Longs (although the fawn colour in Mini Smooths may be caused by the same gene).

If a dog is solid cream then its base colour is red ( $A^yA^y$ ,  $A^yA^l$ ) but it also has 2 copies of the  $c^{ch}$  gene ( $c^{ch}c^{ch}$ ). This gene changes the red coat colour to cream by diluting the pigment.

If a dog is Black and Cream then its base colour is black and tan ( $A^lA^lBB$  or  $A^lA^lBb$ ) but it also has 2 copies of the  $c^{ch}$  gene ( $c^{ch}c^{ch}$ ).

If a dog is Chocolate and Cream then its base colour is Chocolate and Tan ( $A^lA^lbb$ ) and it also has 2 copies of the  $c^{ch}$  gene ( $c^{ch}c^{ch}$ ) – interestingly this is the only colour that without genetic testing you can be almost absolutely certain of its genetic make-up as its colour consists entirely of recessive genes!

## Dapple



Dapple is a pattern caused by the Merle gene (it is the same gene that causes Merle Collies and Harlequin Great Danes). It is given the letter M in Scientific research.

The dapple gene causes a patchy dilution of the coat colour, it can affect any base colour although in reds and creams this may not be visible in adult dogs. It can also affect eye pigmentation resulting in blue or “wall” eyes.

Dapple is a dominant gene (M), therefore to produce a dapple one parent **MUST** be a dapple.

Non dapples have the gene combination “mm”.

If a dog has the “Mm” combination it will be dappled, if it has the “MM” combination it is known as a double dapple and health problems are associated with this combination – namely deafness, reduced eye size or lack of eyes.

Although in Dachshunds we tend to refer to them as Silver Dapples and Chocolate Dapples, to be technically correct the whole base colour should be used i.e. Black and Tan Dapple, Chocolate and Tan Dapple, Black and Cream Dapple etc. as all base colours can also be dappled.

# Problems with Dapples

Two dapples should never be bred together as there is a risk of producing Double Dappled offspring (25% chance for each puppy in a litter). Double Dapples very often have hearing/sight problems.

Dapples should only be bred to Reds or Creams with caution, a red dapple/cream dapple is very difficult to distinguish from a shaded red/cream and therefore may inadvertently be bred to another dapple in the future and produce double dapple puppies.

If the Red happens to be an “ee red” then the “ee” genes mask the dappling pattern so the dog may actually be what is known as a Phantom/Cryptic Merle which can produce dapples in subsequent generations; this is another reason why Dapples should not be bred to Reds.



## Brindle



Brindle is another pattern caused by a Dominant gene, one parent must be Brindle to produce a brindle. This brindle is sometimes called “Tiger Stripped Brindle” and is not the same as Brindle commonly used to describe Wires. Although Wires can have this form of Brindle as well!!

Brindle in Dachshunds is caused by the  $K^{br}$  gene, just one copy of it is enough to produce the characteristic brindle striping on any tan/red/cream parts of the dog. The pattern cannot be seen on the black areas of a black and tan/black and cream as the stripes are indistinguishable from the black base colour.

If the dog is Chocolate and Tan/Chocolate and Cream or Red carrying chocolate ( $A^yA^ybb$ ) then the stripes will be chocolate/liver coloured rather than black.

Unlike dapple there is no known health and welfare issues with dogs which have 2 copies of this gene. A dog that has 2 copies ( $K^{br}K^{br}$ ) will always produce brindle puppies.





## Sable



Sable is a pattern seldom seen in Smooth and Longhaired Dachshunds, however it is the predominant colour of Wirehaired Dachshunds where it is known as Wild Boar (commonly called Brindle in the UK) it is caused by a dominant gene, therefore dogs only need one copy of the Sable gene to be a sable. To breed a sable one parent must be a sable/wild boar. Most recessive smooths bred from 2 Wirehaired parents will be Sable/Wild Boar in colour.

A true sable has a two (or more)-tone hair colour with the dog's base colour being closest to the skin and a darker (usually black) tip to each hair. In fully coated Longhaireds, sables look Black and Tan from a distance but have large amounts of tan on the face and if you lift the coat up there will be red/cream at the base of every hair. A characteristic Widow's peak on the head is also often present. Sables should not be confused with a heavily shaded red and many dark shaded reds are wrongly labelled as sables.

In Smooths, the Wild Boar colour looks like an extreme shaded red but is noticeably different when the two are compared side by side.



## Piebald



Piebald is so far rarely seen in the UK and is not an acceptable colour according to our breed standard which clearly states that no white is permissible. However as some people have recently imported Piebalds from America, the genetics are included.

There are no known health and welfare problems associated with Piebalds although there is evidence in Dachshunds and other breeds that those with completely white heads and ears may have a higher incidence of deafness. There is some evidence to suggest that the pattern has existed in Dachshunds since their inception.

Piebald is thought to be caused by the  $s^p$  gene, it is a recessive gene and therefore Piebalds must have inherited one copy of the gene from each parent. The Piebald gene can affect any of the base colours and other patterns can also be present on Piebald dogs. (It is possible to have a chocolate and cream dapple brindle piebald!!)

Some Piebalds have what is known as Spotting or Ticking which is similar to the Roan or Belton seen in Cocker Spaniels and Setters, it is thought to be caused by a separate gene (possibly TT or Tt).

# Piebald vs Double Dapple

It can be very difficult to distinguish some Piebalds from some Double Dapples (particularly a Dapple Piebald from a Double Dapple).

Double Dapples may or may not have one or 2 Blue eyes.

Piebalds tend to have more extreme amounts of white on their bodies as opposed to Double Dapples which generally just have patches of white, but not always!!

Which is which??



## Dilutes



Dilutes (Blues and Isabellas) are also seldom seen in the UK, however some have recently been imported and a few people are trying to breed them. About 15-20+ years ago there were some Blues registered; however these were not (I believe) the steel blue seen in true dilutes.

The Dilution gene "dd" is a recessive gene and two copies of it are needed to produce a dilute colour. This gene affects the base colour in the following ways:-

- Black and Tan/Cream changes to Blue and Tan/Cream
- Chocolate and Tan/Cream changed to Isabella (fawn) and Tan/Cream

In reds and creams the dilution gene (dd) may just dull the colour and might not be distinguishable from a non dilute red or cream.

Dilute Dachshunds are known to suffer from **Colour Dilution Alopecia** where the hair is very thin, and falls out and the skin is particularly sensitive to infection, dermatitis and skin cancers. Very few adult dilute coloured Dachshunds (Smooth or Long-haired) have no problems and it is hard to find photographs of adult dilutes.

