

COLORS OF MY WORLD: Coat Color in Our Great Danes

A concise overview of basic coat color genetics for Great Dane owners and breeders presented by JP Yousha at the GDCC National Specially 2018. The first part discusses the genetics of ideal color and faults of each color as listed under the standard beginning with Fawn & ending with Harlequin.

**The second portion will be a question and answer period. Please hold all your questions until all individual colors have been outlined & the first portion is complete. However you are free to leave at any time if you've found the information you need. Just please exit quietly so as not to disturb others.
Thank you.**

Note this is NOT intended to be a technical lecture, quite the contrary: so genetic jargon is kept to a minimum & breeder knowledge as well as scientific information is included. This is a seminar for breeders, judges & exhibitors specifically & geared towards a practical approach to breeding & judging coat color & assessing various coat color issues.

-1-

FAWN:

Golden yellow up to deep golden yellow colour with a deep black mask. The golden deep-yellow colour must always be given the preference. Small white spots at the chest and toes are not desirable. Faults: Yellowish-grey, bluish-yellow, greyish-blue, dirty-yellow colour (drab colour), lack of black mask.

$k^y k^y E^m E^m$

K Locus=Fawn= k^y & is the full recessive at this gene. All fawns therefore are homozygous for k^y . Recessive that allows for agouti expression.

E Locus=Extension (MC1R). E^m required for black mask. Fawns can have 1-2 masking genes. Fawns with only 1($E^m E$) can produce maskless fawns. Two masking genes doesn't mean more mask.

Gene tests for K/k & E alleles both exist.

Agouti causes fawn pattern (k recessive allows for its expression). Deep gold is the "clear sable" & "shaded sable" results in soot—shaded (wolf) sable is recessive (are breeds where this is selected). Another (recessive) results in pale, washy fawn & Intensifier (dominant) results in red fawn.

Early Graying Issue: associated with the "super dominant" (melanistic) masking gene but not necessarily directly inherited. Non-heritable factors include clipping & endocrine issues.

Rule of thumb: rid yourself of an unwanted dominant easily—simply don't use animals with the trait & it goes away. Recessives OTOH have to be tracked or tested for: & it "takes two to tango" as a puppy exhibiting a recessive trait got the gene from both parents.

Fawn x Fawn produces only Fawn. But note that blue-faced fawns are possible if both parents carry blue.

-2-

BRINDLE:

Base colour ranging from light golden yellow to golden yellow always brindled with strong black cross stripes. The more intensive the base colour and the more intensive the brindling, the more attractive will be the colour. Small white marks at the chest and toes are not desirable. Faults: Brindle with too dark a

base colour; silver-blue and greyish-blue base colour; dull (faded) brindling; white tail tip.

$k^{br}k^{br} E^mE^m$

K Locus=Brindle= k^{br} & is a recessive at this gene. Brindles can have two brindle genes or carry for fawn. Two brindle genes doesn't mean more striping (i.e. doesn't cause black brindle).

E Locus=Extension (MC1R). E^m required for black mask. Brindles can have 0-1-2 masking genes. Brindles with 0-1 can produce maskless fawns (& brindles).

Gene tests for K/k & E alleles both exist. But no test yet to distinguish fawn recessive from brindle recessive.

Black brindle is dominant over correct brindle. Lack of striping likely recessive (negative modifiers). Fawns & Brindles born dark ("muddy") & color typically clears over first few months, i.e. this is not soot.

Rule of thumb: don't breed fault to fault. That is, do not breed brindles with few stripes to black brindles or washy fawns to sooty fawns. Make sure at least one parent correct in the trait in question.

Brindle x Brindle can produce only Fawn & Brindle.

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(However same rule of blue applies as with fawn.)

-3-

BLUE:

The colour must be pure steel blue as far as possible without any tinge of yellow, black, or mouse grey. Faults: Any deviation from a pure steel-blue colouration

$K^bK^b dd$

K Locus= Dominant Black (Beta-defensin 103). All blues must have at least one dominant K gene.

D Locus=Dilution (MLPH). Blue=dd & is the (only) recessive at this gene. All blues therefore are homozygous for d=(dd).

Blue coat color results from an alternation in the usual pattern of how pigment is deposited in the hair shaft, not from an actual change in pigment color. This disturbance of pigmentation changes light refraction (resulting in characteristic flat vs. glossy appearance) & can also result in broken hairs & poor coat (CDA=color dilution alopecia). Washy shades of blue likely result from other recessive dilution genes such as chinchilla.

WHITE MARKINGS typically seen on Great Danes outside of the Harlequin family are not a result of a white spotting gene. White markings on chest & toes are a result of incomplete pigmentation: periphery &/or midline last to receive pigment. White tends to continue to recede for several months.

**Blue x Blue can produce only Blue puppies (i.e. no Black).
Blue X Black can produce Blue and/or Black puppies.**

NOTE: Blues *can* produce fawn & brindle puppies because Blues & Blacks can carry the k recessives. Many blues & blacks also carry the masking gene sight unseen.

-4-

BLACK:

Glossy black. Faults: Yellow-black, brown-black or blue-black. White markings, such as stripes on the chest, speckled chest and markings on the paws are permitted but not desirable.

$K^b K^b DD$

K Locus= Dominant Black (Beta-defensin 103). All Blacks must have at least one dominant K gene. “DomBlack” is a unique K9 gene; normally a fully black (melanistic=dark) mammal is a recessive condition.

D Locus=Dilution (MLPH). All Blacks must have at least one dominant D gene (otherwise would be Blues).

Black Danes are where most gene flow in the Great Dane breed occurs: i.e. crossing color family “barriers” usually involves Black Danes. So Blacks often spread various color recessives (& other traits) from one color family to another & they can carry many recessive traits “sight unseen.”

Blacks can produce any Dane color and pattern other than those associated with the Merle gene (e.g. Harlequin, Merle, White & Merliquin). Therefore test Blacks for recessives such as fawn & blue to be sure of genotype, as all blacks look alike but they will breed differently, depending on carrier status.

Harl-bred Blacks are discussed under Mantle: unlike other Blacks these dogs typically do carry recessive white spotting genes. Small white markings (toes, star on chest) on Blacks, Fawns, etc. do not normally involve specific coat color genes (so little point in selecting strongly against these minor flaws of color).

-5-

MANTLE:

A black and white dog with a black mantle extending over the body; white blaze or muzzle or both; white chest; white on part or whole of forelegs and hind legs; part or whole white collar; white tipped tail; dark eyes; dark nose. Acceptable but less desirable--lack of collar. Faults: Any variation detracting from the general appearance.

Irish *or* Ss^p piebald?

The Mantle pattern can be produced by two separate & distinct genes. Dogs with 2 Irish white spotting genes & dogs with 1 piebald (excessive white=MITF) gene may both meet the Mantle standard. However there *are* subtle differences in appearance typically & they will breed differently. Piebald Mantles have more erratic markings & white can

extend into the body proper. Irish Mantles have symmetrical markings & white is never found on the torso. Irish Mantles are “true breeding” & produce consistent markings (in a narrow & predictable range). Piebald Mantles are “a hybrid color” & produce a wide (wild) range of markings from mismark black thru various forms of Mantle (broken blankets) & to true piebalds.

A genetic test for the piebald gene (MITF SINE mutation= s^p) exists. Irish spotting is currently being researched & a test is pending.

Mantle x Mantle=Black, Mantle & Piebald. Mantle x Mantle cannot produce any pattern associated with the Merle gene (e.g. Harlequin, Merle, White & Merliquin). However Mantles can carry the harl gene sight unseen & thus not only increase the % of Harlequins in a HarlxMantle breeding, but harl-factored Mantles can produce Harlequins when bred to a Merle or Merliquin.

Freckling isn't ticking (ticking doesn't exist in the breed) & clean white coats are associated with the Irish gene. Black “halo-ing”=more skin than hair is pigmented=can show “bluish”=seen in harls, merles, piebalds & mantles.

-6-

MERLE:

NOT an acceptable Dane color (pending), but a breedable mismark & were there a standard for the acceptable breeding (mantled) Merle, it would read similar to the current standard for the Mantle (presumably).

Mmhh

M Locus-Merle (SILV SINE insertion). All (normal) Merles are Mm: have a single merle mutation (i.e. are heterozygotes). Homozygous (MM) merle=Merlikin. No merle has harl gene.

Merle is a “jumping gene” (retrotransposon) that results in (PMEL17) protein alteration & a “faulty” matrix where pigment “falls out” in places--ending in a dog with areas of full pigment (black), reduced pigment (merle) & no pigment (white). Every Merle & Harlequin is unique: all have “the” merle gene, but the gene they each have varies. If the poly-A tail too short, merle markings are no longer visible on what is still a genetic merle dog (cryptic).

Merle is a co-dominant gene: 2 alleles can produce 3 phenotypes: Black(mm)—Merle(Mm)—Merlikin(MM) aka White Merle. Merle x Merle cannot produce Harlequin or White Danes. However Merle x Mantles can produce Harlequins if Mantle carries for harl.

MERLE IS NOT GRAY: merle is not the same color our Blues have, but rather a brownish-gray. Merle pigmentation varies from a “clear” (or “tarnished”) silvery (fawnish) to pewter (brownish) hue because merle is a dilution gene usually called mouse. Merle dogs cannot have fawn or chocolate patches.

THE MERLE GENE IS A REQUIRED COMPONENT OF THE HARLEQUIN PATTERN: a show-marked Harlequin is a Mantle dog with one copy each of the merle & harl genes. All other DQ mismarks *can* be avoided by breeding choices, but Merles will be born to Harlequin litters regardless.

-7-

HARLEQUIN:

Base colour: pure white with black torn patches irregularly and well distributed over the entire body; pure white neck preferred. The black patches should never be large enough to give the appearance of a blanket or so small as to give a strippled or dappled effect. (Eligible but less desirable are a few small grey spots, also pointings where instead of a pure white base with black spots, there is a white base with single black hairs showing through which tend to give a salt and pepper or dirty effect.) **Faults:** White base colour with a few large spots; bluish-grey pointed background.

HhMm

H Locus=Harl gene. All genetic Harlequins are “dual heterozygotes” (MmHh); they have a single copy of both the harl and the merle mutation. The harl gene removes mid-tone pigments (merling) turning a merle into a harl. All CKC/AKC show-marked Harlequins carry white spotting genes (i.e. have the Mantle pattern) as well.

Harlequin is a merle variant & because of this merle patches are normal on Harlequins. And like other merles, Harlequins are unique as snowflakes in the individual spotting patterns. So while the basic pattern (solid, mantled,

piebald) can be controlled by the choice of recessive white spotting genes, which stabilize the extent of the white markings, other variations in color & markings are expected & unpredictable. NOTE: Harlequins cannot have anything but merle patches in their coat: fawn/chocolate are impossible—patches other than black are merle regardless of hue.

The harl gene has no effect on any coat color other than merle, & so the gene can be carried, sight unseen, by any color of Dane other than those with the merle gene. The harl gene isn't a color gene, but rather is a missense mutation of a proteasome (PSMB7), a necessary component for any cell to survive, so is universally lethal in the homozygote: no prepotent (homozygous) Harlequins exist. Harlequins, unlike all other Dane colors, cannot breed true.

-8-

NON-STANDARD COLORS:

GENETIC PIEBALDS (COLOR-HEADED WHITES): predominately white dogs with "plates" of color (head & tail root, other (but few) large spots of pigment on body)=s^p/s^p=Plattenhund.

HOMOZYGOUS MERLES (WHITES & MERLIQUINS)=MM: Both carry 2 copies of the merle gene & so are at risk for sensory defects. A genetic white differs as also has the harl gene (MMHh. Vs. MMhh).

OTHER PATTERNED MISMARKS (e.g. fawnikins, blue mantles): Same genetics as recognized colors (e.g. Harlequin, Mantle) simply with black pigment replaced by other known Dane recessive.

SOLID MISMARKS (e.g. blue faced fawns, tan pointed Danes):
Result from recessive genes: both parents carriers.

COLOR BREEDING RESULTS:

FAWNxFAWN=FAWN only*

BRINDLExFAWN=FAWN &/or BRINDLE*

BRINDLExBRINDLE=BRINDLE &/or FAWN*

***Any of the above can produce blue fawn/blue brindle when both parents are carriers.**

**BLACK, BLUE or FAWNxBLACK (homozygous)=BLACK
BLUE or BLACK(blue carrier)xBLACK=BLACK &/or BLUE
FAWN or BLACK(fawn carrier)xBLACK=BLACK &/or FAWN
BLUExBLACK (both carry fawn(brindle)/blue)=BLACK, BLUE,
FAWN &/or blue fawn(blue brindle)
BLUExBLUE (homozygous)=BLUE only
BLUExBLUE(both carry fawn/)=BLUE &/or blue fawn**

-9-

COLOR BREEDING RESULTS:

HARLxHARL=HARL(33.3%), MANTLE(25%), MERLE, WHITE (merlikin): also possible Black, Black&White (mismarked black), Piebald, etc. Also puppies with blue and/or fawn pigment combined with various patterns can result if both parents carriers.

HARLxMANTLE=MANTLE(50%), HARL(25-33%)& MERLE: no whites or merlikin possible, but piebalds can result when both parents carriers & various other mismarks (blue, fawn) also possible when both parents carriers.

**HARLxMERLE=MERLE, HARL, MANTLE, WHITE(merliquin): 25% statistically for these four basic colors.
MANTLEXMERLE=HARL, MANTLE & MERLE: If Mantle carries the harl gene, this breeding produces as would a Mantle x Harlequin breeding. Without the harl gene: 50/50 Mantle/Merle results.**

**WHITExMANTLE=MERLE & HARL ONLY: Harlequins produced only with true genetic white &/or when Mantle carries the harl gene.
MERLIQUINxMANTLE=All MERLE unless the Mantle carries the harl gene. NOTE THAT "Mantles" (& "blanket harlequins") produced by last 2 breedings are genetic Merles despite markings(MMxmm=Mm).**

BREEDING OVERMARKED TO UNDERMARKED DOGS (e.g. piebald to heavy harlequin, mismarked black to "harl head," black brindle to few-stripe) is a fault-to-fault breeding (neither parent correct to the standard) & so increases the number of mismarks, especially over the generations. Best long term plan is to have at least one parent correct in every trait.

USING CARRIERS (e.g. fawn, blue, piebald) judiciously is a valid breeding choice, particularly since carrier x carrier breedings can be avoided via genetic testing & so mismarks can be avoided.