

## Understanding Coat Colour Test Results

Several genes are involved in the process of creating the complex coat colours and patterns found in domestic cattle.

One of these is the Melanocortin 1 Receptor (MC1R) gene, also called Extension, that controls the production of black (eumelanin) and red (phaeomelanin) pigments. The three alleles (forms) of this gene are:

- **Dominant black ( $E^D$ )** - Dominant to the other two alleles and animals with this allele are jet black (solid or spotted).
- **Recessive red (e)** - Two copies of this (e) allele will result in red colour.
- **Wild type ( $E^+$ )** – the ancestral/'wild-type' allele " $E^+$ " is neutral, producing a black coat in the presence of " $E^D$ ", a red coat in the presence of "e" and a variety of colours in  $E^+/E^+$  animals, where other genes also influence the pigments produced.

Genotype	Description	Colour
$E^D/E^D$	homozygous dominant black	BLACK
$E^D/E^+$	dominant black/wildtype	BLACK
$E^D/e$	dominant black/recessive red	BLACK
$E^+/e$	wildtype/recessive red	RED
$E^+/E^+$	homozygous wildtype	Varied*
e/e	homozygous recessive red	RED

\* Depends upon modifier genes.

Mating outcomes (statistically):

	$E^D$	$E^D$
$E^D$	BLACK	BLACK
$E^D$	BLACK	BLACK

$E^D E^D \times E^D E^D$   
100% progeny will be Black

	$E^D$	$E^+$
$E^D$	BLACK	BLACK
$E^D$	BLACK	BLACK

$E^D E^D \times E^D E^+$   
100% progeny will be black

	$E^D$	e
$E^D$	BLACK	BLACK
e	BLACK	RED

$E^D e \times E^D e$   
75% progeny will be Black, 25% will be Red.

	$E^D$	$E^+$
$E^D$	BLACK	BLACK
e	BLACK	RED

$E^D e \times E^D E^+$   
75% progeny will be Black, 25% will be Red.

	$E^+$	e
$E^D$	BLACK	BLACK
e	RED	RED

$E^D e \times E^+ e$   
50% progeny will be Black, 50% will be Red

	$E^+$	e
$E^+$	VARIED	RED
e	RED	RED

$E^+ e \times E^+ e$   
75% progeny will be RED, 25% will vary depending upon other factors.

NOTE: Other coat colour genes act as modifiers of these base colours adding white spotting patterns, reorganizing the distribution of red and black pigments (Brindle and Agouti) or diluting the pigments (Dun, Charolais dilution and Simmental dilution). For example, the PMEL17\_delTTC allele causes dilution coat colours such as dun, silver dun, yellow, and cream based on an interaction with the MC1R gene. This dilution factor is common in multiple breeds including Charolais, Hereford, Highland, Galloway, and Simmental.