

Inheritance of Colour in Cattle

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There are a number of sets of genes that determine colour of cattle.

The most common gene sets are:

- ❖ Basic Coat Colour
- ❖ Dilution of basic colour
- ❖ Inhibitor (eg Charolais – prevents colour from forming)
- ❖ Solid Pattern
- ❖ White Face
- ❖ Spotted

This article outlines the inheritance of two of these sets, Basic Coat Colour and Dilution.

Basic Colour Genes

There are three forms of the gene controlling basic coat colour

- Rb** Black Gene.
- R** Red Gene
- r** White Gene

Every animal carries Two Genes for Basic Coat Colour.

- ❖ Where both are the same genes, the animal is **Homozygous** for that gene and will “breed true” for that gene, as it can only pass on one of that type to its progeny.
(eg **RbRb** = Homozygous for Black)
- ❖ Where both are different genes, the animal is **Heterozygous** for that gene and will “not breed true” for either gene. It can pass either type of gene to its progeny.
(eg **RbR** = Heterozygous for Black and Heterozygous for Red)

The Black Gene is Dominant over the Red Gene

(An animal with one of each will be Black or Grey)

There is incomplete dominance between the White Gene and the Black and Red Genes.

(An animal with one White gene and either a Black or Red Gene will be Roan)

Thus there are six possible combinations of the Basic Colour Genes:

RbRb	Animal is Black (or Grey).	Homozygous Black
RbR	Animal is Black (or Grey).	Heterozygous Black, Heterozygous Red
RR	Animal is Red (or Light Red).	Homozygous Red
rr	Animal is White	Homozygous White
Rbr	Animal is Black or Grey Roan.	Heterozygous Black, Heterozygous White
Rr	Animal is Red (or Light Red) Roan.	Heterozygous Red, Heterozygous White

Dilution Gene

There are two forms of the gene controlling dilution of coat colour

- D** Dilution Gene – Dominates, causing the coat colour to be diluted.
- d** Non Dilution Gene – Recessive form of the gene. Does not dilute coat colour

Every animal carries Two of the Dilution Genes.

- ❖ Where both are the same genes, the animal is **Homozygous** for that gene and will “breed true” for that gene, as it can only pass on one of that type to its progeny.
(eg **DD** = HOMOZYGOUS for Dilution and the animal WILL be diluted in colour) OR
(eg **dd** = Recessive and HOMOZYGOUS for Non Dilution - the animal will NOT be diluted)
- ❖ Where both are different genes, the animal is **Heterozygous** for that gene and will “not breed true” for either gene. It can pass either type of gene to its progeny.
(eg **Dd** = Heterozygous for Dilution and the animal WILL be diluted in colour)

Thus there are three possible combinations of the Dilution Gene:

- DD** Dilutes Black to Grey and Dilutes Dark Red to Light Red or Yellow
(Homozygous Diluter)
- Dd** Dilutes Black to Grey and Dilutes Dark Red to Light Red or Yellow
(Heterozygous Diluter)
- dd** Does not dilute Black or Red coat colour.
(Homozygous or Recessive Non Diluter)

Predicting the Progeny Genotype and Appearance (Phenotype)

A simple method of predicting the likely result in the progeny when mating two parents is to place the genotypes of each parent outside a square and then combine the genetic combinations of likely progeny within the square. Consider the following example:

- Parent (1) Appears Black, but may be Heterozygous Black. If so, its genotype is (**R^bR**), and will pass either the (**R^b**) or (**R**) gene to its offspring in random.
As its colour is black, it is HOMOZYGOUS RECESSIVE for the Dilution gene, with a genotype of (**dd**) and will pass only the non diluter (**d**) gene to its offspring.
- Parent (2) Appears Light Red, so it is HOMOZYGOUS RED, with its genotype being (**RR**), and will pass only the Red (**R**) gene to its offspring.
As its colour is a diluted red, it is either HOMOZYGOUS or HETEROZYGOUS for the Diluter gene. We will assume it is Heterozygous, with a genotype of (**Dd**) and will pass either the (**D**) or (**d**) gene to its offspring in random.

<p>PARENT (1) (eg SIRE) Black</p> <p>Heterozygous Black Recessive Dilution</p>	<p>PARENT (2) (eg DAM) Light Red</p> <p>Homozygous Red Heterozygous Dilution</p>						
	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">(R) (D)</td> <td style="padding: 5px;">(R) (d)</td> </tr> </table>	(R) (D)	(R) (d)				
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	<p>PROGENY COMBINATIONS</p> <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px; text-align: center;">(R^b) (d)</td> <td style="padding: 5px; text-align: center;"> Grey (Black-Diluted) (R^b R) (D d) </td> <td style="padding: 5px; text-align: center;"> Black (Black-NonDiluted) (R^b R) (d d) </td> </tr> <tr> <td style="padding: 5px; text-align: center;">(R) (d)</td> <td style="padding: 5px; text-align: center;"> Light Red (Red-Diluted) (R R) (D d) </td> <td style="padding: 5px; text-align: center;"> Dark Red (Red-NonDiluted) (R R) (d d) </td> </tr> </table>	(R^b) (d)	Grey (Black-Diluted) (R^b R) (D d)	Black (Black-NonDiluted) (R^b R) (d d)	(R) (d)	Light Red (Red-Diluted) (R R) (D d)	Dark Red (Red-NonDiluted) (R R) (d d)
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(R) (d)	Light Red (Red-Diluted) (R R) (D d)	Dark Red (Red-NonDiluted) (R R) (d d)					

Most Common Combinations

PARENT (1) – eg SIRE	PARENT (2) – eg DAM	PROGENY	PROGENY (Genotype)
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SIMMENTALS

Dark Red (Recessive Dilution)	Dark Red (Recessive Dilution)	Dark Red	Recessive Dilution
Dark Red (Recessive Dilution)	Light Red (Homo Dilution)	Light Red	Heterozygous Dilution
Dark Red (Recessive Dilution)	Light Red (Hetero Dilution)	$\frac{1}{2}$ Dark Red $\frac{1}{2}$ Light Red	Recessive Dilution Heterozygous Dilution
Light Red (Homozygous Dilution)	Light Red (Homo Dilution)	Light Red	Homozygous Dilution
Light Red (Homozygous Dilution)	Light Red (Hetero Dilution)	Light Red	$\frac{1}{2}$ Homozygous Dilution $\frac{1}{2}$ Heterozygous Dilution
Light Red (Heterozygous Dilution)	Light Red (Hetero Dilution)	$\frac{1}{4}$ Dark Red $\frac{1}{2}$ Light Red $\frac{1}{4}$ Light Red	Recessive Dilution Heterozygous Dilution Homozygous Dilution

BLACKS and REDS

BLACK (Homozygous Black)	Dark Red (Recessive Dilution)	Black	Hetero Black, Recess Dilution
BLACK (Homozygous Black)	Light Red (Homo Dilution)	Grey	Hetero Black, Hetero Dilution
BLACK (Homozygous Black)	Light Red (Hetero Dilution)	$\frac{1}{2}$ Black $\frac{1}{2}$ Grey	Hetero Black, Recess Dilution Hetero Black, Hetero Dilution
BLACK (Heterozygous Black)	Dark Red (Recessive Dilution)	$\frac{1}{2}$ Black $\frac{1}{2}$ Dark Red	Hetero Black, Recess Dilution Recessive Dilution
BLACK (Heterozygous Black)	Light Red (Homo Dilution)	$\frac{1}{2}$ Grey $\frac{1}{2}$ Light Red	Hetero Black, Hetero Dilution Heterozygous Dilution
BLACK (Heterozygous Black)	Light Red (Hetero Dilution)	$\frac{1}{4}$ Black $\frac{1}{4}$ Dark Red $\frac{1}{4}$ Grey $\frac{1}{4}$ Light Red	Hetero Black, Recess Dilution Recessive Dilution Hetero Black, Hetero Dilution Heterozygous Dilution

RED SIMMENTAL & RED ANGUS

DARK RED (Recessive Dilution)	Dark Red (Recessive Dilution)	Dark Red	Recessive Dilution
DARK RED (Recessive Dilution)	Light Red (Homo Dilution)	Light Red	Heterozygous Dilution
DARK RED (Recessive Dilution)	Light Red (Hetero Dilution)	$\frac{1}{2}$ Dark Red $\frac{1}{2}$ Light Red	Recessive Dilution Heterozygous Dilution