

D- SCIENTIFIC INFORMATION

Genetics of Colour

The Colours of the Fjord Horse

An adaptation of "The Colours of the Fjord Horse" by Tor Nestaas, revised in 2002

Phenotype- Genotype

One cannot decide from the looks (phenotype) of a horse what kind of genotype of colour it has. By studying the pedigree and the colours of his ancestors, one can get some certainty of what genotype a horse may have. But only by noticing what colour the offspring are can one be certain what kind of colour genotype the horse has.

The Heredity of the Colours - Terminology

In this survey, international terms, which are common, are used. The late General Inspector of Fjord Horses, *Johs. Loen* charts different genotypes in his pioneering scientific studies in the years 1929 to 1938 [*Fargenedarvinga hos Vestlandshesten (Fjordhesten)*]. As some are used to the terminology, which Loen used in his thesis, those terms, stands in parenthesis below.

- A** (H) - gene for limitation (distribution) of black
- B** (G) - gene for black
- C** (F) - gene (basic factor) for colour
- C^{cr}** (f) - gene for dilution of colour (dilution factor)
- D** (E) - gene for dun or wild colour (pale or agouti factor)

The gene for limitations of black, **A**, restrict the colour black to the darker hairs in forelock, mane and tail.

Genes comes in pair, one half from each parent, and small letters indicates that the gene is missing (**aa** - **bb**). The *red* and *yellow* duns do not have the gene for black, and accordingly their stripes etc., are brown or reddish. The *greys (blue duns)* do not have the limitation gene for black. If they did not have the gene for dun or wild colour, **DD** (earlier the term **Z** was used), they would have been black all over.

The gene for dilution, **C^{cr}**, is the factor, which gives the uls dun and yellow dun varieties. It can also occur in the genotypes of grey horses. In double, **C^{cr}C^{cr}**, this factor gives white and walleyed horses. These white horses have light blue irises, and are therefore not real albinos. In everyday language, they are misleadingly called albino.

A term used to describe the phenotype of the brown horse with double dilution factor (**Aa/AA,Bb/BB,C^{cr}C^{cr}**) is "perlino". The term for the double diluted chestnut horse (**aa/Aa/AA,bb,C^{cr}C^{cr}**) is "cremello" with the sub-category of "blue eyed cream" for those individuals with blue iris. In addition the Fjord Horse is always also homozygous for the agouti factor (**DD**) and therefore has an additional genetic factor for paler colour. The term Wiersema (see "*Het Paard in zijn Kleurenrijkdom*") suggests for the double diluted brown dun Fjord is "agouti perlino". The double diluted red dun Fjord would be "agouti cremello". As the effect of the dilution factor is not as obvious in black horses and blue duns, the genotype (**aa,BB/Bb,C^{cr}C^{cr},DD**) would still be called "blue dun".

Below, is listed the different genotypes of colour a Fjord horse can have. There are in all 18 different genotypes of colours: 4 for Brown dun - 3 for Red dun - 4 for Grey (blue dun) - 4 for Uls dun - 3 for Yellow dun. For each of these genotypes it is mentioned what the different combinations of colour can give as a result.

Genotypes of Brown dun

1. AA BB CC DD

Individuals of this genotype bred to brown and red duns, gives only brown dun offspring. Bred to greys, uls duns and yellow duns, it can give brown dun and uls dun offspring.

2. AA Bb CC DD

Individuals of this genotype bred to brown and red duns can give brown and red dun. Bred to greys, uls and yellow duns, it can give brown, red, uls and yellow dun offspring.

3. Aa BB CC DD

Individuals of this genotype bred to brown and red duns, can give brown dun and grey. Bred to greys, uls and yellow duns, it can give brown dun, grey and uls dun.

4. Aa Bb CC DD

Individuals of this genotype bred to brown and red duns, can give brown dun, red dun or grey. Bred to greys, uls and yellow duns, the result can be brown dun, red dun, grey, uls dun or yellow dun offspring.

Genotypes of Red (chestnut) dun

All three genotypes of red dun bred to red duns gives only red dun offspring. Bred to yellow duns, all three genotypes give red dun or yellow dun offspring.

1. AA bb CC DD

Individuals of this genotype bred to brown duns can give brown and red dun. Bred to greys and uls duns, it can give brown, red, uls or yellow dun.

2. Aa bb CC DD

Individuals of this genotype bred to brown duns give brown dun, red dun and grey. Bred to greys and uls duns, it can give brown dun, red dun, grey, uls and yellow dun.

3. aa bb CC DD

Individuals of this genotype bred to brown duns give brown dun, red dun and grey. Bred to greys, it can give red dun, grey or yellow dun. Bred to uls duns, it can give brown dun, red dun, grey, uls or yellow dun.

Genotypes of Grey (blue dun)

1. aa BB CC DD

Individuals of this genotype bred to brown and red duns, can give brown dun and grey. Bred to greys, it can only give grey. Bred to uls and yellow duns, it can give brown dun, grey and uls dun.

2. aa Bb CC DD

Individuals of this genotype bred to brown and red duns, gives brown dun, red dun and grey. Bred to greys, it can give red dun, grey and yellow dun. Bred to uls and yellow duns, it can give brown dun, red dun, grey, uls and yellow dun.

3. aa BB CC^{Cr} DD

Individuals of this genotype bred to brown and red duns can give brown dun, grey and uls dun. Bred to greys, it can give grey, very light grey or perlino. Bred to uls and yellow duns, it can give brown dun, grey, uls dun and perlino.

4. aa Bb CC^{Cr} DD

Individuals of this genotype bred to brown and red duns, can give brown dun, red dun, grey, uls and yellow dun. Bred to greys, it can give red dun, grey, yellow dun and cremello. Bred to uls and yellow duns, it can give brown dun, red dun, grey, uls dun, yellow dun and perlino/ cremello.

Genotypes of Uls dun

In general, uls dun bred to uls and yellow duns, gives 25 % white and walleyed, so-called perlino/ cremello, offspring. The same occurs when uls dun is bred to greys of genotype 3 and 4.

1. AA BB CC^{Cr} DD

Individuals of this genotype bred to brown and red duns, gives brown and uls dun. Bred to greys, uls, and yellow duns, it can give brown dun, uls dun and perlino.

2. AA Bb CC^{Cr} DD

Individuals of this genotype bred to brown and red duns, gives brown, red, uls and yellow dun. Bred to greys, uls and yellow duns, it can give brown, red, uls and yellow dun, and perlino/ cremello.

3. Aa BB CC^{Cr} DD

Individuals of this genotype bred to brown and red duns can give brown dun, grey and uls dun. Bred to greys, uls and yellow duns, it can give brown dun, grey, uls dun and perlino.

4. Aa Bb CC^{Cr} DD

Individuals of this genotype bred to brown and red duns, can give brown dun, red dun, grey, uls and yellow dun. Bred to greys, uls and yellow duns, it can give brown dun, red dun, grey, uls and yellow dun, and perlino/ cremello.

Genotypes of Yellow dun

All three genotypes of yellow dun bred to red duns, gives red or yellow dun offspring. Bred to yellow duns, all three genotypes gives red dun (25 %), yellow dun (50 %) or cremellos (25 %).

1. AA bb CC^{Cr} DD

Individuals of this genotype bred to brown duns gives brown, red, uls and yellow dun. Bred to greys and uls duns, it can give brown, red, uls and yellow dun, and perlino/ cremello.

2. Aa bb CC^{Cr} DD

Individuals of this genotype bred to brown duns give brown dun, red dun, grey, uls and yellow dun. Bred to greys and uls duns, it can give brown dun, red dun, grey, uls dun, yellow dun and perlino/cremello.

3. aa bb CC^{Cr} DD

Individuals of this genotype bred to brown duns, can give brown dun, red dun, grey, uls and yellow dun. Bred to greys, it can give red dun, grey, yellow dun and *perlino/cremello*. Bred to uls dun, it can give brown dun, red dun, grey, uls and yellow dun, and perlino/cremello offspring.

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