

# ***Single Gene Effects in Limousin***

## **Polledness, Colour and Protoporphyrin**

Most characteristics of cattle such as growth and fertility are controlled by many or multiple genes. A few characteristics such as polledness, colour and protoporphyria are controlled by a single pair of genes.

The outcome of particular joinings for single gene traits can be accurately predicted once basic genetic principles are understood. This breednote aims to give Limousin breeders an understanding of these principles.

### ***Dominance***

For most single gene traits there are dominant and recessive forms of the gene. The combination of dominant and recessive genes in the pair of genes carried by each animal determines what the animal looks like.

For example, take the polled gene in Limousins. The polled gene is dominant and the horned gene is recessive. If an animal carries two horn genes (pp) it will be horned. If it carries two polled genes (PP) it will be polled. If it carries a horn gene and a polled gene (Pp) it will be polled because the polled gene is dominant.

### ***Homozygous and Heterozygous***

Animals which carry a pair of genes which are the same are called homozygous (homo means same). For example, for polledness, the animals carrying two polled genes (PP) or two horned genes (pp) are both homozygous.

However, if the genes are different (Pp) the animal is heterozygous (hetero means different).

While we can be confident that all horned animals are homozygous for the horned gene (pp) we cannot tell if a polled animal is homozygous (PP) or heterozygous (Pp) except by a progeny test.

### ***Predicting the Outcome***

Sometimes the outcome of a mating can be predicted with complete accuracy. For example a homozygote horned bull (pp) over a homozygote horned cow (pp) will produce 100% homozygote horned progeny (pp).

In other cases we can only predict the probability of the outcome.

For example, a heterozygote polled bull (Pp) crossed with homozygote horned cows (pp) will produce 50% polled progeny (Pp) and 50% horned progeny (pp).

Figure 1 shows the outcomes of all possible horned and polled combinations.

### ***Scurrs***

Scurrs are short stubby horns which are only expressed when the polled condition is present. They are controlled by a different pair of genes to the polled/horned genes.

The genes for the scurred condition are shown as Sc and sc.

To further complicate the picture the scurred gene is sex linked as follows:-

SS Both males and females are scurred

Ss Males are scurred and females are smooth polled

ss Both males and females are smooth polled

There are probably two or three different scur gene pairs controlling the scurred condition and additionally Bos Indicus cattle have a different type of scur to those seen in Bos Taurus cattle. However, the above combinations will be true for Limousin cattle in most cases.

### ***Colour***

The same principles as described above apply for the red and black colour with black being dominant and red being recessive.

BB (homozygous) All black

Bb (heterozygous) All black

bb (homozygous) All red

Colour patterns in other breeds such as Charolais, Murray Greys and Galloways are controlled by many genes and are much more complicated than the red and black condition described above.

### ***Protoporphyrin***

Protoporphyrin is due to the presence of a defective gene that is normally responsible for the formation of the enzyme ferrochelatase which is involved in the combination of iron and protoporphyrins to form haem, a component of haemoglobin.

If two defective genes are present (homozygous defective) then the animal is likely to exhibit the symptoms of protoporphyrin (photosensitisation).

If one defective gene is present (heterozygous) the animal will be a carrier but is very unlikely to suffer from photosensitisation.

If both genes are normal (homozygous normal) the animal will be normal.

The various mating combinations portrayed for the polled gene are identical for black colour.

## *Testing to prove the homozygous polled or heterozygous makeup*

### **DNA Tests:**

#### **Colour:**

A DNA test is available to test for homozygous black animals using hair, blood or semen (details and costs attached)

#### **Polledness:**

A DNA test is available in the USA to test for homozygous polled animals. The test uses a marker gene so can only provide a 95 per cent probability that the animal is homozygous polled. An alternative way to test if an animal is homozygous polled is to join the animal to horned animals. If ten polled progeny occur then the chance of the test animal being heterozygous and not homozygous is 1 in 1,024. In other words will be 99.9% certain our test animal is homozygous polled.

#### **Protoporphyrin:**

A DNA test is available in Australia to test for those animals which appear normal but carry a defective gene. These are known as protoporphyrin carriers. NZ breeders wishing to submit hair samples for testing should contact Daryl Bott (09) 232 1468.