Genetic Codes
Technote 11

HIGHLIGHTS

- The tested status of animals for genetic defects and characteristics has been updated
- An internationally agreed 3-letter code system was implemented August 2013
- ADHIS now reports test results for genetic characteristics like A1/A2, polled and coat colour

Table 1 Traits currently reported and their corresponding code

Trait	Tested Positive	Tested Negative	Description
Genetic Defects			C= Tested positive as carrier F= Tested as free or non-carrier
BLAD	BLC	BLF	Bovine Leukocyte Adhesion Deficiency. A lethal genetic metabolic disease of cattle affecting the animal's immune system and consequently its ability to fight harmful organisms.
Citrullinaemia	CNC	CNF	A lethal genetic enzyme deficiency interrupting the normal processing of ammonia in the brain. Calves affected with citrullinaemia appear normal at birth, but usually die within 4-6 days.
DUMPS	DPC	DPF	Deficiency of Uridine Monophosphate Synthase. A genetic metabolic disease which is lethal at the embryonic stage (approximately at day 40 of pregnancy).
Mulesfoot	MFC	MFF	Also known as syndactylism - the fusion of the two toes of the foot (resembling a thin mule's foot).
CVM	CVC	CVF	Complex Vertebrael Malformation. CVM is a lethal condition. It causes early abortion due to foetal death or, if the calf survives to term, it usually dies within a week of birth.
Factor XI	XIC	XIF	In Holstein dairy cattle, Factor-XI deficiency can cause some cows to have a tendency to bleed. Haemorrhaging or excessive bleeding can be fatal in some cases.
Brachyspina	BYC	BYF	Brachyspina syndrome is a genetic defect that causes physical deformities as well as embryonic death. Affected calves have severally reduced bodyweight and exhibit a shortening of the spine with long and thin limbs.
Genetic Characteristics			
Red Carrier	RDC	RDF	True red coat colour gene.
Black Red	BRC		Calves may be born with a red coat but turn almost totally black after a few months of age. This gene is dominant over the true red gene.
Variant Red	VRC		A second mechanism of red colour inheritance involving a different gene. Dominant over black coat colour.
Polled (Current indirect test)	POS POC	POF	Polled refers to the absence of horns or scurs – animals born naturally hornless. • POS Tested true polled (homozygous PP) • POC Tested carrier of polled (heterozygous Pp) • POF Tested free of polled
A1A2 Milk	A22, A12	A11	A1/A2 milk refers to the presence or absence of the A2 proteins in the milk A22- Tested true A2; A12 – Tested carrier (one copy of A2) A11 – Tested negative (No copy of the A2 gene)

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Explaining genetic codes

To provide breeders with the tools they need to make informed breeding decisions it is important to identify heritable, sometimes undesirable, genes that animals can carry. Genetic defects refer to genetic disorders such as BLAD and CVM whilst genetic characteristics refer to potentially desirable traits including coat colour, polled and A1A2 milk. The following outlines the common theory underlying inheritance of these traits.

Simple inheritance traits

Simple inheritance traits are traits largely controlled by one major gene. These are 'yes' or 'no' characteristics that are either present or absent in an animal. In some cases, simple inheritance traits may involve more than one gene however the pattern of inheritance remains fairly simple. Testing for these genes allows breeders to effectively select for or against the trait/disease. Most of the traits outlined in table 1 fit into this category.

Multi-gene traits

Multiple gene traits are controlled by a larger number of genes. This group includes many economically important traits such as kilograms of protein and daughter fertility. In these cases, Australian Breeding Values are used to identify superior/inferior animals as it much more difficult to clearly identify animals with the favourable variants of each gene. Multi-gene traits are not discussed in this fact sheet.

Dominant vs recessive?

The majority of simple inheritance traits can be divided into either 'dominant' or 'recessive'.

The different variants of a gene which regulate the expression of a trait are known as alleles. For each gene all cattle inherit one allele from their mother and one from their father.

Where the allele controlling a trait is dominant the animal only requires one copy for that trait to be expressed. Conversely a recessive trait requires both alleles (one from each parent) to be expressed.

A good example of this is coat colour. In the following example both animals are heterozygous black (Bb) ie they are black cattle who carry both the black and red alleles. The uppercase 'B' refers to the dominant black allele and the lower case 'b' refers to the recessive red allele.
When these two animals are mated there are four possible outcomes:

- A 25% chance the offspring will be a homozygous black calf (BB),
- A 50% chance of a heterozygous black calf (Bb) and
- A 25% chance of a red calf (bb).

Figure 1: Example mating between heterozygous coat colour

		Sire Heterozygous black	
		B	**b**
Dam Heterozygous black	**B**	**BB**	**Bb**
	b	**Bb**	**bb**

Because black is dominant over red the heterozygous offspring (Bb) will be black. The calf will only have a red coat when it inherits the red coat allele from both parents.

How do I use the codes to make sound breeding decisions?

If your herd contains a strong pedigree influence from animals known to carry a genetic defect it is particularly important to keep an eye out for the corresponding code (refer to table 1). To avoid undesirable matings use an inbreeding report to avoid joining closely related animals. For cows identified as carriers of a genetic defect, avoid using a bull with a three letter code ending in C. Where a genetic code ends in 'F' the animal has been tested as free from carrying that trait.

To include desirable genetic characteristics in your breeding objective, look for the relevant 'tested positive' code (eg RDC for red carrier).

DataGene will record and publish codes for these traits across its range of web-based publications such as Displaybull, Good Bulls Guide spreadsheets and Selectabull.

Genetic codes are available from DataGene publications once the animals have been tested and the results supplied to DataGene.

The absence of a code means that the animal either does not have a pedigree containing carrier animals, has not been tested for the given trait, or that this information has not been supplied to DataGene.

For more information

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