Pfizer Animal Health
Animal Genetics

FREQUENTLY ASKED QUESTIONS

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A discussion of DNA, economically relevant traits and other topics that provide a foundation in genomics

1. **What is an economically relevant trait?**

   A trait is an observable or measurable characteristic of an individual. An economically relevant trait is one that directly affects profitability through an association with a specific cost of production or income stream. Examples of economically relevant traits include marbling and feed efficiency.

2. **Are all economically relevant traits heritable?**

   Economically relevant traits vary in level of heritability, measured as the percentage of observed variation that is due to underlying gene effects that can be transmitted from one generation to another. While heritability may differ between populations, in general, traits such as fertility tend to be more lowly heritable than traits such as growth rate and tenderness, which exhibit moderate to high degrees of heritability.

3. **If a trait is lowly heritable, does that mean that it cannot be improved genetically?**

   Traits with a low degree of heritability can still be improved genetically, though not as rapidly as more highly heritable traits. The rate of genetic progress is not controlled by heritability alone; the amount of observable (phenotypic) variation and the accuracy with which the variation can be identified are also key factors.

4. **What is DNA and how is it organized?**

   DNA, or deoxyribonucleic acid, is the building block of the genetic code. A DNA molecule is composed of two strands of nucleotides wrapped around one another and connected at the bases to form a double helix. DNA is present in all nucleated cells in an animal, with cattle having approximately 2.7 billion nucleotides in the code. DNA is organised into 30 pairs of chromosomes in cattle. We refer to the complete DNA makeup of an animal as its genome.

5. **Do we know the full code (i.e., sequence) of DNA for cattle and other livestock?**

   The full code set for an animal's genome is comprised of about 2.7 billion connected bases. The genome of a number of species has been sequenced including humans, cattle, chickens, horses, and the platypus! Additional commercially important species such as sheep and swine are currently being sequenced.

6. **What is a gene?**

   A gene is the most basic unit of heredity. It consists of a relatively short sequence (several thousand nucleotides) of DNA at a specific location on a chromosome that determines a particular characteristic in an organism through the production of a specific protein end-product.

7. Do we know the identity of all the genes that impact economically relevant traits?

We now know, as a result of the recently completed bovine genome sequencing project, that there are over 30,000 uniquely identifiable genes in the bovine genome. Current technologies have enabled us to identify how a few of these genes impact economically relevant traits. An excellent example is the effect of the calpastatin gene on beef tenderness. New technologies will lead to greater knowledge of which specific genes control which traits, as well as how they interact together to influence performance.

8. How many genes are responsible for the expression of economically relevant traits?

We do not yet know exactly how many genes impact economically relevant traits, but quantitative genetics research in beef cattle and other livestock indicates that many genes are likely to have small- to moderate-sized effects on performance for any given trait.

9. What is a DNA marker?

A DNA marker is a variation in the DNA code, mapped to a specific location in the genome. DNA markers can be genotyped and may be associated with one or more physical characteristics.

10. Are all DNA markers alike?

Markers can differ in mode of inheritance, physical size (number of base pairs), functionality and how they are applied in genetic improvement. The prevailing type of marker now being used in DNA testing for traits is known as a single nucleotide polymorphism (SNP). SNP markers vary at a single base location in the genome, creating two different alleles (or forms) of the marker.

11. How does a DNA marker relate to a gene?

A DNA marker can actually be located directly within the gene sequence that causes a change in the trait of interest. More commonly, DNA markers are linked to (inherited with) a nearby gene that causes a change in the trait of interest.

12. Are the effects of DNA markers the same for different breed sub-populations around the world?

Often they are similar, although the more divergent or distant a population is from another, the greater chance there is for the effect of markers to vary. In beef cattle, the greatest expected differences are likely to occur between *Bos Indicus* and *Bos Taurus* sub-populations.

13. Does a DNA marker only relate to one trait?

Many traits are genetically correlated to one another due to the fact that genes can impact multiple traits; for example, the effect of growth hormone on growth rate and carcase composition. Likewise, DNA markers that are either within these genes or linked to them are likely to have effects on multiple traits. It is also possible for a marker to have a positive effect for one trait and a negative effect for another.

14. How is an animal's makeup (i.e., genotype) for a DNA marker determined?

An individual's genotype is fixed at birth with the inheritance of one chromosomal copy from each of its parents. The animal's genotype for the marker is determined by analysing the DNA sequence variation at the marker location in the genome using high throughput DNA genotyping technologies that are routinely used around the world for a variety of applications.

15. How accurate is an animal's marker genotype?

Modern genotyping technologies and applications are highly accurate. The techniques used to detect an animal's genotype are capable of identifying a change of a single base in an animal's genome at each DNA-marker location.

16. Will an animal's marker genotype change during its lifetime?

No, an individual's genotype is unique and fixed not long after fertilisation of an egg by a sperm, and remains fixed throughout its lifetime.

For more information, please contact customer service on 0880 228 278 or visit www.pfizeranimalgenetics.co.nz.