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Gene technology – terminology and definitions

The term 'genetic technology' embraces a wide range of techniques. Some these techniques the organic movement rejects outright, some it accepts, and there are others it is still not sure about. Every specialist field has its own language, and understanding the jargon jungle is the first step in gaining a good understanding of the issues and the key to an informed debate. This factsheet sets out to demystify some of the terms you are most likely to come across, and to explain the context is which you are likely to hear them. They are organised into three broad areas: Basic units of heredity; reproductive and evolutionary processes; gene technologies in plant and animal breeding.

Basic units of heredity

This section describes the basic units of heredity, what they are made of, how they are organized.

Phenotypes

A **phenotype** is the observable characteristics of an organism; the things that you can see or measure, and **phenomics** is the study of phenotypes. These include morphology (height, shape, weight, colour etc) biochemical and physiological properties or behavior. The phenotype is the partly determined by an organism's **genes** and partly by the environment in which it lives.

Genes and related terminology

Genes are the basic unit of heredity in a living organism. All living things depend on them to hold the necessary information to build and maintain their cells and pass genetic traits to offspring. There are two or more versions of a gene, and these versions are called **alleles.** For example, the gene determining eye colour can have brown, green and blue alleles. The **genotype** is a collective term for all the genes that are present in an organism and **genomics** is the science of interpreting genes. Genes themselves are segments of **DNA (deoxyribonucleic acid).** Every cell has an enormous quantity of DNA so it (and therefore the genes) is very tightly packed into long coils called **chromosomes,** and which are located in the **nucleus** of the cell. DNA, genes or the number of chromosomes in a cell can change, and this called a **mutation.** Mutations are an important part of the evolutionary process.

Reproductive processes

One of the key functions of genes is to pass information from one generation to the next, and this process is, of course, done through reproduction. These are some of the main concepts and terms:

Fertility and sterility

Organisms that cannot pass genetic material from one generation to the next are **sterile. Male sterility** is the failure of plants to produce functional anthers, pollen, or male gametes and it is important in breeding because it prevents unwanted self-pollination. **Cytoplasmic male sterility** is a special type of male sterility which is inherited through the female line. Reproduction is usually restricted to within a species but sometimes interbreeding can occur between two animals or plants of different species, genera or even (but very rarely) families. When this happens, **hybrids** are produced.

Types of reproduction

Plants can reproduce both sexually and asexually. **Vegetative propagation,** involving the culture of plant parts such as stem and leaf cuttings, is an example of asexual reproduction, where there is only one parent and the offspring are genetically identical. **Cross pollination** (sometimes called **allogamy**) is a form of sexual reproduction, in which

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pollen (male sex cell) of one plant unites with the egg (female sex cell) of a different plant to produce offspring with a range of different characteristics. Many plants have both male and female parts, so an individual plant can fertilise itself, in which case they are said to be **self-fertile.** However, other plants have chemical or physical barriers to self-pollination.

Clones and cloning

Clones are individuals that are genetically identical. They are usually produced by asexual reproduction, where the offspring are essentially carbon copies of the parent. However, it can come about through sexual reproduction as in the case of identical twins (although they will look slightly different, because the phenotype depends on environmental as well as genetic influences). **Clonal propagation** is the asexual reproduction of plants that are genetically uniform and originated from a single individual.

Hybrids

In the context of plant breeding the term **'hybrid'** is also used for a cross between populations, breeds or cultivars within a single species. This rearranging of the genetic material between populations or races is often called **hybridization**.
Hybridization is very common in both plant and animal breeding programmes because hybrids can have desirable characteristics more strongly expressed than in either parent/ population. **Hybrid vigour** or **heterosis** is a term used when hybrid offspring perform better than the parents.

An **F1 hybrid** is the first generation of a cross. They don't breed true, so F1 hybrid seed has to be repeatedly produced from pure parent lines, which is an expensive process.

Genetic technologies in animal and plant breeding

This section is about the techniques we use to help us understand genotypes, develop new varieties or breeds, and produced genetically modified plants and animals.

Genetic markers

A **genetic marker** is a gene or DNA sequence with a known location on a chromosome and associated with a particular gene or trait. They are used a bit like landmarks on a map, and help researchers 'get their bearings' when they are looking for other genes associated with them. This can speed up the process of selection and is a technique is widely used in plant and animal breeding, and is accepted under the organic standards.

Genetic engineering and GMOs

Genetic engineering moves sections of DNA (the **transgenes**) from one organism to another. A **genetically modified organism** (GMO) is an organism whose genetic material has been altered using these techniques**. Transgenic organisms** are a subset of GMOs and are organisms in which the transgenes originated in a different species. Soya which is resistant to the herbicide Round-up is an example of this. There are also many applications outside agriculture. For example, insulin is made by inserting genes for insulin normally found in mammals into bacteria.
The use of GM and transgenic plants and animals is prohibited by the organic standards. Genes are not usually transferred directly from one organism to another. There is usually an intermediate step in which DNA from different sources are combined into new set of genes called a **vector.** The vector is then transferred into an target organism, giving it modified or novel genes. These techniques are generally known as **recombinant DNA technologies**.
Co–existence is the simultaneous existence of genetically modified crops in the neighbourhood of conventional and organic crops. **Adventitious contamination** occurs when GM plants have self-seeded or pollinated non-GM crops.

Protoplast fusion

A protoplast is a cell (plant, bacterial or fungal) from which the entire cell wall has been removed. **Protoplast fusion** (sometimes called **somatic fusion)** is a laboratory technique where plant cells from two distinct species are fused together to form a new hybrid plant, called a **somatic cell hybrid,** with the characteristics of both. This is a type of genetic modification, and is used to produce **some** F1 hybrids. The main UK organic certification bodies allow organic growers to use Hybrids produced by this method, but the BDAA does not. However traditional plant breeding produces F1 hybrids by natural methods which are acceptable to all certification bodies.

These are just some of the more common terms you may come across. We will review and update this factsheet in the light of discussions in the future.