

## GLOSSARY

**Amino acids:** A group of chemically simple substances that are linked together to make up proteins. Human proteins contain around 20 different amino acids of which nine are “essential” but cannot be made in the liver: instead we obtain them from our food. A good mixed diet will contain them all, but in many poor areas of the world where there is little food choice these essential components are missing. Genetic manipulation of crops to improve the protein composition in food plants is one route to making good these deficiencies.

**Antibiotic-resistance marker gene technology:** In the first generation of genetically modified crops, **marker genes** of bacterial origin but with resistance to antibiotics were coupled with a gene of interest (that codes for a desirable characteristic) as a way of selecting successfully transformed plant cells. Under this procedure, after the gene transfer has been carried out, the cells are treated with an antibiotic so that only the transformed cells survive, making it possible to identify those that also possess the gene of interest. Although the marker gene serves no purpose after this procedure, it remains part of the genetically modified plant and is virtually impossible to remove. Kanamycin is the antibiotic most commonly used, but it is now being phased out because of concern about the possible development of antibiotic resistance, and the procedure now uses other marker genes that do not require antibiotic selection.

**Apomixis:** Replacement of normal sexual reproduction in many plants and some animals by asexual reproduction without fertilisation. Apomictically produced offspring are genetically identical to the parent. Apomixis occurs in at least 33 families of flowering plants through many different mechanisms, and has evolved many times from sexually reproducing relatives.

**Biodiversity:** A broad term. It can mean the existence of a wide variety of *species* of plants, animals and microorganisms within a natural community or habitat. Or it can refer to communities within a particular environment, so-called *ecological diversity*. Then there is *genetic diversity* – wide genetic variation within an individual species – which is important for plant breeders when identifying parent lines with genes for delivering desirable traits.

**Bio-economy/bio-based economy:** These are terms referring to economic activity based on the use of biotechnology in industrial processes. The term is widely used by government agencies, international organisations and biotechnology companies. (see also **Industrial biotechnology**)

**Bioinformatics:** An important multi-disciplinary field, drawing on computer science, mathematics, engineering, etc., to help store, organise, analyse and retrieve biological data. Software tools have been developed, for example, to help make sense of gene sequence and mutation data from plants and to understand better the links between gene expression and protein synthesis – a key step in determining how crops function.

**Biorefinery:** A refinery that uses biomass from either waste or specially grown plant materials to produce fuels such as diesel, ethanol and value-added polymer chemicals such as plastics.

**Biotechnology:** Techniques for applying biological processes to produce desired substances. Not to be confused with genetic modification (GM), which is only one kind of biotechnology. The production of beer, wine, cheese and antibiotics have long relied on the use of fungi (e.g. yeast) and bacteria (e.g. *Escherichia coli*). Now plant scientists are employing modified bacteria or viral gene vectors to introduce novel genes into engineered crops.

**C<sub>3</sub> plants:** Plants in which – during photosynthesis – carbon dioxide is first fixed into a compound containing three carbon atoms. The group includes most broadleaf plants and those that grow in temperate zones. C<sub>3</sub> plants, which originated during the Mesozoic and Paleozoic eras (some 100–570 million years ago), still represent approximately 95 per cent of the Earth's plant biomass.

**Carson, Rachel:** An American marine biologist and conservationist whose writings are credited with launching the global environmental movement. *Silent Spring*, in particular, published in 1962, drew widespread public attention to the environmental risks associated with extensive use of synthetic pesticides. Although *Silent Spring* was met with fierce opposition, it spurred a change in pesticide policy in the USA and around the world.

**Cellular imaging:** Live cellular imaging is the study of living cells using time-lapse microscopy to obtain a better understanding of their biological functioning by visualising their cellular processes.

**Cisgene, cisgenesis:** Literally, having the same beginning. This refers to genes that come from the same or a closely related organism, as opposed to **transgenes**, which come from unrelated plants or organisms that could not otherwise be bred by conventional methods.

**Club of Rome:** The Club of Rome was founded in 1968 as an informal association of independent thinkers from the worlds of politics, business and science – men and women who are interested in contributing in a systemic interdisciplinary and holistic manner to a better world, with a common concern for the future of humanity and the planet. Its aims are to identify the most crucial problems which will determine the future of humanity through integrated and forward-looking analysis; to evaluate alternative scenarios for the future and to assess risks, choices and opportunities; to develop and propose practical solutions to the challenges identified; to communicate the new insights and knowledge derived from this analysis to decision makers in the public and private sectors as well as to the general public; and to stimulate public debate and effective action to improve prospects for the future.

**Commodity crops:** Crops grown, typically in large volume and at high intensity, specifically for the purpose of sale on the international commodities market (e.g. maize, wheat, rice, soybeans), as opposed to for direct consumption or to a factory for processing.

**Companion cropping (intercropping):** The planting of different crops close together for pest control, pollination, provision of habitat for beneficial creatures, maximised use of space, and to otherwise increase crop productivity. It is used by farmers and gardeners in both industrialised and developing countries and has been used for many centuries in cottage gardens in England and small-scale farming in Asia and Africa.

**Conventional fermentation:** The process used in brewing and wine making for the conversion of sugars to alcohol. The same process, followed by distillation, uses starch and sugar components of typically cereal crops (maize, wheat or barley) or sugar crops (cane or beet) to obtain pure ethanol (bioethanol) for use as a transport biofuel.

**Cry proteins:** Proteins produced by the common soil bacterium *Bacillus thuringiensis* and genetically engineered into crop plants to provide resistance against insect pests. They are toxic to certain insects (e.g. corn borers, corn rootworms, mosquitoes,

black flies, army worms, tobacco hornworms, some types of beetles), but are harmless to mammals and most beneficial insects.

**DNA, RNA:** (see **Gene**)

**Ehrlich, Paul:** An American biologist who became widely known with his controversial book *The Population Bomb*, published in 1968, which predicted serious consequences from population growth in the face of limited resources. Some predictions were perhaps overstated, but Ehrlich's unease about the size of the human population and its impacts on the environment have, generally, been vindicated.

**Expression (gene):** The process by which information from a gene directs the synthesis of a functional product of the gene. These products are often proteins, but in non-protein-coding genes the product is a functional RNA (e.g. ribosomal and transfer RNA necessary for protein synthesis). Gene expression is necessary for all forms of life – multicellular plants and animals, bacteria and viruses – to generate the macromolecular machinery for life.

**Extension services (agricultural):** The application of research and new knowledge to agriculture through educating farmers in agricultural and business skills, especially in developing countries. Communication and learning activities carried out for rural farmers, often through government agencies and supported by international development organisations such as the World Bank.

**Farnesene:** A group of related chemical compounds. One is found in the coating of apples and other fruits, and is responsible for the characteristic green apple odour. Another is released by aphids (green or black fly) as an alarm **pheromone** upon death to warn away other aphids. Several plants, including potato, have been shown to synthesise this pheromone as a natural insect repellent.

**First/second-generation:** These terms refer, respectively, to a technology in the form in which it is first developed and to the form in which it then later develops, for example, first- and second-generation genetically modified (GM) plants and first- and second-generation biofuels.

**Forage:** Plant material (mainly plant leaves and stems) eaten by grazing livestock. Historically, the term was applied only to plants eaten by the animals directly as pasture, but it is also used for plants cut for fodder, especially as hay or silage.

**Gene, genome, genomics, gene expression, gene discovery:** Genes are the molecular units of heredity encoded in a molecule of DNA – the familiar double helix-shaped structure described by Watson and Crick in their historic paper in *Nature* in 1953. They consist of long chains of smaller units called nucleotides (adenine, cytosine, guanine and thiamine, abbreviated to A, C, G and T), the sequences of which determine the gene's function. The total complement of genes, packaged in chromosomes within cells, is the **genome**. When a gene is switched on and active – **expressed** – the information carried by DNA in the form of a chemical code is copied by the formation of another molecule, messenger RNA, which carries the coded message to the protein synthetic machinery in the cell (ribosomes) where it is translated into a protein. That is the function of genes – to make proteins that will carry out a variety of tasks within the organism. In plants, some control growth and height, for example, others insect resistance or yield. (*see also Expression*)

**Gene flow:** Gene flow (or gene migration) is the transfer of genes from one population of closely related plants to another, for example by the transfer of pollen by wind, or in some cases by water or animals, between populations which can interbreed.

**Gene therapy:** The use of DNA to treat a genetically based disease by delivering therapeutic DNA into a patient's cells to alleviate or cure the disease. The most common form of gene therapy involves using DNA that codes for a functional therapeutic gene to replace a mutated gene that produces a disease or disability.

**Genetic modification (or manipulation) (GM) and genetic engineering:** All refer to the use of modern biotechnology techniques to change the genes of an organism such as a virus, bacterium, plant or animal. A genetically modified organism (GMO) is any living organism that has been changed using genetic modification.

**Genome evolution:** The process by which a genome sequence or size changes over time. The study of genome evolution involves several fields of research such as structural analysis of the genome, the study of ancient genomes and the comparison of genomes and the genetic information they contain between different species, genera, families, etc., of living organisms – viruses, bacteria, plants, animals.

**Genomics:** The study of genes.

**Genotype:** The genetic make-up or characteristics of a cell, organism or individual, usually with reference to a specific characteristic.

**Germplasm:** The total hereditary material of plants – in the form of DNA – transmitted to offspring through germ cells and giving rise to succeeding generations. Germplasm banks in the form of seeds have been set up to try to conserve the genetic material which may be lost when older crops are replaced by newer varieties.

**GM foods:** Genetically modified, genetically engineered, the product of recombinant DNA technology – these terms are pretty well interchangeable. Much of the debate and controversy surrounding novel biotechnology turns on GM crops and foods, but these are not the only form of newly developed crop varieties.

**Green Revolution:** An important series of research, development and technology transfer initiatives for increasing global agriculture production that began in the late 1940s and largely came to fruition in the 1960s. Norman Borlaug, the Father of the Green Revolution, built on his early success in Mexico by taking a programme of plant breeding, irrigation and financing of agrochemicals to India and other parts of the world, where yields improved dramatically.

**Greenhouse gases:** Pollutant gases, largely from human activity (anthropogenic impact), that absorb infrared radiation from the sun and thereby contribute to global warming – the enhanced greenhouse effect. Carbon dioxide from car exhausts, power stations and other fossil-fuel sources is the main concern. But other pollutants contribute, namely nitrogen oxides, ozone, methane and chlorofluorocarbons.

**Hectare:** The standardised metric unit for measuring land – 10,000 square metres. It is used throughout this book, though some people often prefer to use the acre (1 hectare = 2.471 acres).

**Homologous gene targeting:** The genetic technique in which a gene sequence is exchanged between two similar or identical molecules of DNA (in a genome) to modify a gene. It can be used to delete or add a gene and introduce mutations into the DNA for any gene, regardless of the function or size of the gene.

**Horizontal gene transfer:** The transfer of genes between organisms, commonly bacteria, other than by conventional sexual or asexual reproduction. Also termed lateral gene transfer, it differs from the transmission of genes from the parental generation to offspring via sexual or asexual reproduction. Horizontal gene transfer has been shown to be an important factor in the evolution of many organisms, and may even be the dominant form of genetic transfer among single-celled organisms.

**Hybrid:** The offspring of plants that are sexually compatible and hence can interbreed, and have genomes that are similar or closely related.

**Hybrid vigour:** Hybrid vigour, or heterosis, is the improved or increased functioning of any biological characteristic in a hybrid offspring by combining the genetic contributions of its parents. This is often observed as greater biomass, speed of development and fertility than in either parent.

**Induced systemic resistance:** This works by preconditioning a plant's defences against a pathogen (e.g. fungus, bacteria or virus) by prior infection or treatment that induces resistance against a subsequent infection by a pathogen or attack by a parasite.

**Industrial biotechnology:** Known also as “white biotechnology” (as against “red” for medical biotechnologies and “green” for agricultural biotechnologies), is the application of biotechnology for industrial purposes, including industrial fermentation, which includes the practice of using cells such as microorganisms, or components of cells like enzymes to generate industrially useful products such as chemicals, food and animal feed, detergents, textiles and biofuels. In doing so, biotechnology uses renewable raw materials and may contribute to lowering greenhouse gas emissions and moving away from a petrochemical-based economy. (*see also* **Bio-economy**)

**Intercropping:** *see* **Companion cropping**

**Legumes:** Plants in the family Leguminosae, or the fruit or seed of such a plant. Legumes are grown agriculturally, primarily for their food grain seed, for livestock forage and silage, and as soil-enhancing “green manure” because they are capable of fixing nitrogen from the atmosphere in specialised root nodules, which then release the nitrogen to the soil when the plant decays, making it available for other plants. Well-known legumes include alfalfa, clover, peas, beans, lentils, mesquite, carob, soybeans and peanuts.

**Linkage drag:** The reduction in fitness of the offspring produced by plant breeding due to deleterious genes being introduced together with the beneficial gene or genes during backcrossing.

**Lodging:** Occurs when the stems of cereal plants cannot support the weight of the plants. All cereal crops such as wheat, rice and barley, and all varieties, are

susceptible in varying degrees. Severe lodging is costly due to its effects on grain formation and associated harvesting problems and losses as it takes much more time to harvest a lodged crop than a standing one, if it can be harvested at all.

**Low-till agriculture:** The planting practice in which disturbance of the soil is kept to a minimum. It results in considerable savings in farmers' time, agricultural machinery, diesel fuel, etc. By reducing ploughing, it also conserves the structure of the top-soil which determines its water-holding capacity and the ease with which plants put down roots, as well as maintaining the carbon storage capacity of the soil. (*see also* **No-till farming**)

**Macronutrients/micronutrients:** As the terms imply, macronutrients are required in large amounts for maintaining health, micronutrients in small amounts. Macronutrients – protein, carbohydrates and fats – provide the body with energy, while micronutrients – minerals including iron and zinc, and vitamins including A, C, D and the B complex – play a vital role in the body's metabolism and resistance to disease. Both types of nutrients are normally available in a balanced diet.

**Malthus, Thomas:** British author of an extremely influential book, published in 1789, *An Essay on the Principle of Population*. Malthus feared that continuing population growth in the face of limited resources would lead to hunger and poverty on a grand scale. His ideas influenced the pioneering theorists of evolution by natural selection, Charles Darwin and Alfred Russel Wallace.

**Marker genes, marker-assisted selection/breeding:** Markers are genes or short sequences of DNA that serve as a tag for another, closely linked gene. In plant breeding, markers are used to map and select genes of interest – those that code for desirable characteristics (traits), more efficiently than traditional selection systems.

**Mass spectrometry:** A technique now in common use in analytical laboratories for identifying and studying the physical, chemical or biological properties of a great variety of compounds. It is used for determining the elemental composition of a sample, the masses of particles and molecules, and for elucidating the chemical structures of molecules.

**Metabolism, metabolic pathway:** All the chemical reactions occurring in living organisms. Plants obtain their basic starting material for these reactions from their external environment: carbon dioxide, water and minerals such as nitrogen, phos-

phorus and potassium. The internal chemistry proceeds by a number of steps – the metabolic pathways – which are facilitated by enzymes as catalysts.

**Mitochondrion (pl. mitochondria):** A specialized subunit found within most of the cells that make up plants, animals, fungi, and many other forms of life (with the exception of largely single-celled organisms such as bacteria). Mitochondria are involved in making energy available to the cell, and other tasks such as signalling, cellular differentiation, the inheritance of certain characteristics, the control of the cell cycle and cell growth and death. Some cells have only a single mitochondrion, whereas others can contain several thousand.

**Micronutrient:** *see* **Macronutrient**

**Modelling:** A simulation, usually using a computer, of a real-world phenomenon or system, often for predictive purposes. Weather forecasts are an everyday example. For agriculture, models can be used to forecast production, population growth, environmental impacts and so on. Their reliability depends both on the quality of the mathematical design and the data put into it.

**Molecular genomics:** The field of genetics that applies recombinant DNA, DNA sequencing and bioinformatics to sequence, assemble and analyse the function and structure of genomes (the complete set of DNA within a single cell of an organism).

**Molecular plant breeding:** The application of molecular biology techniques in plant breeding, including gene discovery, genetic engineering/modification, genetic transformation and marker-assisted selection. (*see also* **Gene and Markers**)

**Nanoscience, nanotechnology, nanobiotechnology, nanofoods:** Nano- (meaning dwarf) science deals with matter at the vanishingly small scale of billionths of a metre. It is now possible to design and build structures at the nanoscale that can be introduced into foods. Examples are nanofilters to remove bacteria from milk without the need for boiling, or sensors to detect pathogens.

**New platform:** An integrated internet-based facility providing up-to-date techniques for improving plant breeding.

**Next-generation sequencing:** The technique in which the sequence of a small fragment of DNA is determined from signals emitted as each fragment is re-

synthesised from a strand of DNA in parallel manner across millions of reactions. It enables the rapid sequencing of long stretches of DNA making up whole genomes, and produces hundreds of gigabytes of data in a single sequencing run.

**Nitrogen fixation:** The process by which nitrogen in the atmosphere is converted into ammonia and stored in microorganisms and plants. It is essential for all forms of life because nitrogen is required to synthesise the basic building blocks of plants, animals and other life forms, e.g., nucleotides for DNA and RNA and amino acids for proteins. Therefore nitrogen fixation is essential for agriculture. Microorganisms that can fix nitrogen are prokaryotes – bacteria and archaea (which differ from bacteria in certain characteristics) – called diazotrophs. Some higher plants (especially members of the bean family – see **Legumes**) and some animals (termites) have formed associations (symbiosis) with diazotrophs.

**No-till farming (NTF):** Sometimes called zero tillage or direct planting, this is a method of growing crops that does not disturb the soil through tillage (ploughing, removing weeds, preparing for planting and creating irrigation channels). The effect is to increase the amounts of water and organic nutrients in the soil and decrease erosion. NTF also helps to reduce the amount of diesel used by farm machinery and thereby cut cost and pollution, and helps to maintain the biodiversity of soil organisms such as microbes, arthropods and earthworms. (*see also* **Low-till agriculture**)

**Nuclear transfer:** A procedure in which a cell's nucleus is removed and placed into an egg cell with its own nucleus removed so that the genetic information from the donor nucleus controls the resulting cell. Such cells can be induced to form embryos and this process was used to create the Dolly, the cloned sheep.

**Orphan crops:** Crops that until recently have received little attention from scientific researchers and scant funding for improvement, despite their importance for food security in poorer/developing regions of the world. They are defined as a group of crops that are vital to the economy of developing countries due to their suitability to the agro-ecology and socio-economic conditions, but which remain largely unimproved.

**Pathogen:** Any disease-causing microorganisms, such as bacteria, viruses, fungi and protozoa, which can invade a plant (or animal), establish themselves and multiply to the detriment of the host.

**Pharmacogenomics/pharmacogenetics:** While these terms are broadly interchangeable, pharmacogenomics is the analysis of entire genomes, across groups of individuals, to identify the genetic factors influencing responses to a drug, while pharmacogenetics is the study of an individual's genetic make-up in order to predict responses to a drug and guide prescription.

**Phenotype analysis:** The analysis of the composite of an organism's observable characteristics or traits such as its structure, development, biochemical or physiological properties, fitness and behaviour resulting from the expression of an organism's genes together with the influence of environmental factors, and the interactions between the two.

**Pheromone:** A chemical secreted or excreted that triggers a social response in members of the same species. There are alarm pheromones, food trail pheromones, sex pheromones, and many others that affect behaviour or physiology. Pheromones are used by single-celled to complex multi-cellular organisms and particularly by insects, while some vertebrates and plants also use them to communicate.

**Photosynthesis:** The chemical process by which plants synthesise the essential organic compounds of which they are made from carbon dioxide and water, using the energy of sunlight. Since all other forms of life depend directly or indirectly on plants for food, photosynthesis is the basis of life on the planet. It has also been responsible for generating all the oxygen in the atmosphere, as oxygen is released during the process.

**Plant-incorporated protectants:** Pesticides produced by plants and the genetic material necessary for the plant to produce the substance, for example the pesticidal protein produced by a gene from the soil bacterium *Bacillus thuringiensis* introduced into the plant's genetic material by genetic engineering. The plant then manufactures the pesticidal protein that controls the pest when it feeds on the plant.

**Precautionary principle:** The precautionary principle (or precautionary approach) states that if an action or policy is suspected of carrying a risk of causing harm to the public or to the environment, but there is no scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those promoting the action or policy. The general principles of risk management apply:

- proportionality between the measures taken and the chosen level of protection;

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- non-discrimination in application of the measures;
- consistency of the measures with similar measures already taken in similar situations or using similar approaches;
- examination of the benefits and costs of action or lack of action;
- review of the measures in the light of scientific developments.

**Precursors:** In biological processes, substances from which others, usually later in chains of substances, are formed.

**Protein, proteome, proteomics:** Proteins play a vital role in the functioning of all living matter. They are the workforce within plant cells where they have a variety of roles – as enzymes and structural elements, etc. The full complement of proteins in the cell is the **proteome**, while **proteomics** – the study of the proteome – enables us to identify, characterise, quantify and follow changes in the protein network of the plant cell and thus gain deep insights into the real-time activity of a plant at the level of individual molecules.

**Provitamin:** A substance with little or no vitamin activity that can be converted by normal metabolic processes into the active vitamin. An example is provitamin A – beta-carotene – the synthesis of which has been genetically engineered into Golden Rice.

**Recombinant DNA (rDNA):** Genetically engineered DNA prepared by using laboratory methods to insert genes from one species of an organism (or, recently, chemically synthesised DNA) into the cells of an organism of a different species, creating sequences that would not otherwise be found in biological organisms. Such DNA becomes part of the host's genetic make-up and is replicated from one generation to succeeding generations.

**R&D:** Research and development. In the domain of modern plant biotechnology, this means uncovering new basic scientific knowledge about, for example, genes that confer certain characteristics such as stress or pathogen tolerance and then applying those insights to develop new products or processes that will improve current crops.

**Semiochemicals:** Chemical substances that carry a message for the purpose of communication between individuals of the same or different species. (*see also Pheromone*)

**Sequencing:** The process of determining the exact nucleotide sequence of a section of DNA – spelling out the individual building blocks of a fragment of DNA and leading to the identification of individual genes. Whole genome sequencing (also known as full, complete or entire genome sequencing) determines the complete DNA sequence of an organism’s genome at a single time. The Human Genome Project did this for the whole of our genetic make-up.

**Selection pressure:** The extent to which an organism – such as a crop plant – with particular characteristics is either favoured or challenged by the demands of the environment in which it is being cultivated. Climate change, for example, is exerting a new set of selective pressures on many crops.

**Staple crops:** The most commonly consumed foods in the diet of people in a specific region. They vary according to the availability of seed or other planting materials and the topography of the land, type of soil and climate. They are usually cereal grains or starchy root vegetables that can be stored for a long time. The most globally important include rice, maize, wheat and potatoes. Others are barley, oats, rye, buckwheat, cassava, lentils, millet, sorghum, cow pea, soybeans, sweet potato and yam.

**Sustainability:** In agriculture, the ecosystem-oriented approach to farming, which is sensitive to practices that could cause long-term damage.

**Sustainable agricultural intensification:** Defined as “producing more output from the same area of land while reducing the negative environmental impacts”. Both agricultural and environmental outcomes are pre-eminent under sustainable intensification.

**Synthetic biology:** The synthesis of complex, biologically based systems with functions that do not exist in nature applied at all levels of biological structures from individual molecules to whole cells, tissues and organisms. A developing field of biology which, in essence, is expected to enable the design of biological systems in a rational and systematic way. What separates synthetic biology from genetic engineering is that, rather than altering an already existing DNA strand, synthetic biology puts these “blocks” together from scratch to build an entirely new strand of DNA which is then placed into a living cell.

**Systemic acquired resistance:** The resistance response of the whole plant following exposure to a pathogen (anything that can produce a disease).

**Systems biology:** A biology-based interdisciplinary field that focuses on studying complex interactions in biological systems, and which aims to model and discover the properties of cells, tissues and organisms functioning as a system. These typically involve metabolic networks or cell signalling networks – the complete set of metabolic and physical processes that determine the physiological and biochemical properties of a cell. Systems biology makes heavy use of mathematical and computational models.

**Tissue culture:** Growing the tissues of plants (or other organisms) in a suitable culture medium containing appropriate nutrients. The technique gives insights into how growth and cellular differentiation are controlled. Breeders are able to use it to regenerate complete plants by vegetative propagation.

**Trait, complex trait:** Crop traits or characteristics such as herbicide tolerance or insect resistance can be introduced singly or in combination – so-called trait stacking, as with maize or cotton engineered to be both insect-resistant and herbicide-tolerant. Some traits are determined by single genes, others by a number of genes (complex traits).

**Transgene:** (*see Cisgene*)

**Transcriptome:** All the RNA molecules produced in one or a population of cells. This reflects the genes being actively expressed at any one time. Transcriptomics or expression profiling is the technique for examining these expression levels during plant growth and development.

**Vegetative reproduction (or propagation, multiplication or cloning):** A form of asexual reproduction in plants by which new organisms arise from the parent plant without the production of seeds or spores. Natural vegetative propagation is mostly found in herbaceous and woody perennial plants, and typically involves structural modifications of the stem, although any horizontal, underground part of a plant (whether stem, leaf or root) can contribute to vegetative reproduction. Man-made methods of vegetative reproduction are usually enhancements of natural processes, but range from rooting cuttings to grafting and artificial propagation by laboratory tissue culture.

## ACRONYMS

<b>AATF</b>	African Agricultural Technology Foundation
<b>ABNE</b>	African Biosafety Network of Expertise
<b>AGRA</b>	Alliance for a New Green Revolution in Africa
<b>AOCC</b>	African Orphan Crops Consortium
<b>AU</b>	African Union
<b>ASSAF</b>	Academy of Sciences of South Africa
<b>BREAD</b>	Basic Research to Enable Agricultural Development
<b>BSE</b>	Bovine spongiform encephalopathy
<b>CBD</b>	Convention on Biological Diversity
<b>Bt</b>	<i>Bacillus thuringiensis</i>
<b>DNA</b>	Deoxyribonucleic acid
<b>EFSA</b>	European Food Safety Authority
<b>EIQ</b>	Environmental Impact Quotient
<b>EC</b>	European Commission
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>GEAC</b>	Genetic Engineering Appraisal/Approval Committee
<b>GHI</b>	Global Hunger Index
<b>GM</b>	Genetic modification, genetically modified
<b>GMO</b>	Genetically modified organism
<b>IAASTD</b>	International Assessment of Agricultural Science and Technology for Development
<b>ICRAF</b>	World Agroforestry Centre
<b>IP</b>	Intellectual property
<b>IPR</b>	Intellectual property rights
<b>ISAAA</b>	International Service for the Acquisition of Agri-biotech Applications
<b>ISR</b>	Induced systemic resistance
<b>KBBE</b>	Knowledge-based bio-economy
<b>LEAF</b>	Linking Environment And Farming
<b>MAGIC</b>	Multi-parent Advanced Generation InterCross
<b>MAS</b>	Marker-assisted selection
<b>NEPAD</b>	New Partnership for Africa's Development
<b>NGO</b>	Non-governmental organisation

<b>NGS</b>	Next-generation sequencing
<b>NSF</b>	National Science Foundation
<b>NTF</b>	No-till farming
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>PEER</b>	Partnerships for Enhanced Engagement in Research
<b>PRSV</b>	Papaya ringspot virus
<b>R&amp;D</b>	Research and development
<b>RNA</b>	Ribonucleic acid
<b>SAR</b>	Systemic acquired resistance
<b>SNP</b>	Single nucleotide polymorphism
<b>TILLING</b>	Targeted Induced Local Lesions IN Genomes
<b>UN</b>	United Nations
<b>USAID</b>	US Agency for International Development
<b>USDA</b>	US Department of Agriculture
<b>WHO</b>	World Health Organization
<b>WTO</b>	World Trade Organization