GLOSSARY OF TERMS

Abiotic	Non-biological; abiotic factors include frost, heat, drought, cold and salt.
Agrobacterium tumefaciens	A naturally occurring soil bacterium that is capable of inserting DNA (genetic information) into plants. Used in agricultural biotechnology to carry transgenes into plants.
Alien species	Species introduced intentionally or unintentionally to locations beyond the native range of the species (usually taken as post-1500). Also known as non-indigenous, non-native, exotic or introduced species. See also invasiveness.
Allele	Any one of a number of alternative forms of the same gene occupying a given position on a chromosome.
Allelopathy	Interaction between two different species involving chemicals produced by one, which suppresses the growth or reproduction of the other.
Allergenic/allergens	Substances that cause an allergic reaction.
Anaphylaxis	A severe and rapid allergic systemic reaction to contact with an allergenic trigger substance. The classic form involves prior sensitisation with later re-exposure, producing symptoms via an immunological mechanism.
Antigen	A macromolecule that is recognized by antibodies or immune cells and can trigger an immune response.
Antisense techniques	Method for down regulating the expression of particular genes by putting a ‘reverse’ version or ‘mirror image’ version of the gene, or part of the gene, into a cell.
Apomixis	Biological reproduction by seeds without fertilisation, meiosis or production of gametes. The asexual production of seeds.
Atrazine	See Triazines.
Back-crossing	Crossing an individual with one of its parents or with a genetically equivalent organism. The offspring of such a cross are referred to as the backcross generation or backcross progeny.
Bacteriophage	A virus that infects bacteria. Altered forms are used as cloning vectors.
Base pairs	Abbreviation: bp. Two nucleotides, one on each of the opposite complementary strands of DNA or RNA, connected

	via hydrogen bonds are called a base pair. In DNA, adenine and thymine, as well as guanine and cytosine, can form a base pair. The length of a nucleic acid molecule is often given in terms of the number of base pairs it contains. Modified to kbp (kilobase pairs, often used to measure transgene sizes) and Mbp (megabase pairs, used to measure total genome sizes).
Biodiversity	A measure of the range and abundance of living organisms, this includes diversity within species and between species.
Bioinformatics	The science of managing and analysing biological data using advanced computing techniques. Especially important in analysing genomic research data. See also *in silico*.
Biolistics	Method for introducing genetic material into plant cells. DNA is coated onto micro-particles (gold or tungsten) that are fired into plant tissue.
Bolters	Plants that flower prematurely; most commonly sugar beet bolters which flower in the first year after planting rather than the second year.
Break crop	A crop grown to benefit the soil and reduce pests and pathogens.
Bromoxynil	A nitrile herbicide that inhibits photosynthesis (in photosystem II).
Canola	Oilseed rape (used in North America).
Chimaera	(or chimera) An organism made up of cells containing different genetic information.
Chloroplast	Specialised plastid (general term for plant cell organelles which carry non-nuclear DNA) that contains chlorophyll. They are the site of solar energy transfer and some important reactions involved in starch and sugar synthesis. Chloroplasts have their own DNA genome and this is generally inherited through the female parent.
Clearfield	A commercial herbicide tolerant system using a group of conventionally bred crops with resistance to the broad-spectrum herbicide imidizole.
Cleistogamy	Relating to a flower that does not open and is self-pollinated in the bud.
Codon	A group of three consecutive nucleotides that represent the unit of genetic coding by specifying a particular amino acid during the synthesis of polypeptides in a cell. Each codon is

	recognised by a transfer RNA carrying a specific amino acid, which is incorporated into a polypeptide chain during protein synthesis.
Codon usage	As there are 64 possible triplet combinations of the 4 nucleotides (4x4x4) that are present in mRNA and DNA and only 20 amino acids, there is approximately a 3-fold excess of triplet combinations available to encode these amino acids. This means that codons can be changed without altering the amino acid sequence of the protein they encode. For some amino acids the codons most commonly used to encode them differ between eukaryotes (e.g. plants) and prokaryotes (e.g. bacteria). Therefore, the codons of a transgene derived from a prokaryote may be changed so that expression of the transgene in plant cells is more efficient.
Co-existence	In this Review, co-existence refers to the simultaneous but separate cultivation of crops by different agricultural methods (e.g. conventional non-GM, GM, organic, non-food industrial and certified seed crops).
Coleaoptera	Insect order that includes beetles.
Conjugation	Unidirectional transfer of plasmid DNA from one bacterium to another, involving cell-to-cell contact. The plasmid usually encodes the majority of functions necessary for its own transfer.
Conservation headlands	Crops at the edges of fields that are not treated with agrochemicals (part of qv Countryside stewardship scheme).
Containment	Growth conditions for organisms including bacteria and plants where they are not freely released in the local environment.
Countryside Stewardship scheme	A Government-run scheme that makes payments to farmers and other land managers to enhance and conserve English landscapes, their wildlife and history and to help people to enjoy them.
Crop rotation	Crops on a specific area of land are changed year by year in a planned sequence.
Defective interfering (DI) RNA	Small RNA molecules derived from viral RNA by extensive deletion. DI RNA depends on the original virus for replication and usually reduces the level of replication of the host (helper) virus.

Defective virus	A virus that, by itself, is unable to reproduce at all, or at the level of the wild type virus when infecting its host cell, but that can grow in the presence of another virus. This other virus provides the necessary molecular machinery that the first virus lacks.
Diploid	Having two complete sets of chromosomes, most commonly one set of paternal origin and the other of maternal origin.
DNA	Deoxyribonucleic acid. The molecule that encodes genetic information. DNA is a double-stranded molecule held together by weak bonds between base pairs of nucleotides. The four nucleotides in DNA contain the bases adenine (A), guanine (G), cytosine (C), and thymine (T). In nature, base pairs form only between A and T and between G and C; thus the base sequence of each single strand can be deduced from that of its partner. The structure of DNA (double helix) was published in 1953 by Crick and Watson.
Ecosystem	The complex of a living community and its physical environment, functioning as an ecological unit in nature.
Embryo rescue	A sequence of tissue culture techniques used to enable a fertilised immature embryo, resulting from an interspecific cross (between plants from different species), to continue growth and development (when it may not otherwise), until it can be regenerated into an adult plant.
Encapsidation	Packaging of viral genetic material (RNA or DNA) in a regular protective, geometric array (shell) or coat (capsid) protein molecules.
Epidemiological monitoring	See Post-marketing monitoring
Epidemiological surveillance	See Post-marketing surveillance
Epitopes	The individual surface feature of an antigen that elicits the production of a specific antibody (monoclonal) in the course of the immune response. Each antigenic determinant, typically a few amino acids in size, causes the synthesis of a different antibody and thus exposure to a single antigen may result in the expression of a number of antibodies (polyclonal).
Eukaryote/ eukaryotic	Cell or organism with membrane-bound, structurally discrete nucleus and other well-developed subcellular compartments. Eukaryotes include all organisms except viruses, bacteria, and bluegreen bacteria (algae).

Exon	Protein-coding DNA sequence of a gene**.** Many eukaryotic genes are composed of a mosaic of exons and introns.
F1 hybrids	The initial hybrid generation resulting from a cross between two genetically unlike parents.
Farm-saved seed	Retaining some seed from a harvest to sow in following years on the same farm, rather than buying in new seed produced commercially.
Fertilisation (self and cross)	Union of two gametes from opposite sexes to form a zygote. There are different categories: 1. Self-fertilisation (selfing): fusion of male and female gametes from the same individual. 2. Cross-fertilisation (crossing): fusion of male and female gametes from different individuals.
FISH	Fluorescence *in-situ* hybridisation. A method for locating particular sections of DNA on chromosomes.
Fitness	The survival value and the reproductive capability of an individual, compared to that of competitor individuals of the same or other species within a population or an environment.
Fixation	Situation in which only one allele for a given gene/locus is present in a population. This can occur as a result of direct selection where the allele delivers a greater level of fitness; because of indirect selection, where the locus is linked to a gene that is subject to direct selection; or because of genetic drift. Also: Nitrogen fixation: the process of conversion of gaseous nitrogen in the atmosphere to compounds which can be metabolized by plants, a process which can be carried out by some bacterial species.
Fusion protein	A polypeptide synthesised from a chimeric gene. The different fragments of DNA are joined so that their protein coding sequences are in the same reading frame. The resulting construct is transcribed and translated as a single gene, producing a single protein.
Gamete	Mature male or female reproductive cell.
Gene	The unit of heredity transmitted from generation to generation during sexual or asexual reproduction. The simplest gene consists of a segment of nucleic acid that encodes an individual protein or a length of RNA.
Gene construct	The DNA unit, usually including transgenes, promoters and selectable markers, which is used to make a GM plant.

Gene flow	The transfer of genes between different individuals e.g. pollen-mediated gene transfer between sexually compatible plants. Also refers to the transfer of genes from one plant population to another through seed dispersal or the movement of regenerative plant parts, (e.g. tubers), or whole plants. This Review also considers the possibility of plant genes being transferred and stably integrated into the genomes of soil and gut microbes and into viruses that infect plants (see horizontal gene flow).
Gene product	RNA and proteins.
Gene stacking	Accumulation of genes conferring different traits in one plant resulting from cross-fertilisation or transformation with several gene constructs. Also, see transgene stacking.
Genotype	The genetic constitution of an organism, as distinguished from its physical characteristics (its phenotype).
Glufosinate ammonium	Used to provide post-emergence, broad spectrum control of annual grasses and broad-leaved weeds. Glufosinate ammonium can be sprayed after emergence if the crop is tolerant to it. This herbicide acts by inhibiting an enzyme that is responsible for ammonia detoxification ultimately leading to the cessation of photosynthesis. The trade names of herbicides containing glufosinate ammonium include: Basta, Liberty, Ignite, and HOE 39866.
Glyphosate	Systemic herbicide that is used for post-emergence, broad spectrum control of annual and perennial broad-leaved and grass weeds. Can be sprayed after emergence if the crop is glyphosate tolerant. Acts by inhibiting an amino acid metabolism pathway that exists in higher plants and microorganisms, but not in animals. Inactivated on contact with clay particles in soil, and requires no hazard warning symbols on packaging. The trade names of some herbicides in which glyphosate is the active ingredient are: Roundup, Rodeo, Touchdown, and MON-0573.
GM	Genetically modified/ Genetic modification. Altering the genetic material of an organism in a way that does not occur naturally by mating and / or natural recombination.
GM derived	Products that are derived from genetically modified organisms, including products (e.g. some vegetable oils or enzymes used for making cheese) in which it is not possible to detect any DNA or protein.
GMO	Genetically modified organism. An organism in which the genetic material has been altered in a way that does not occur

	naturally by mating and / or natural recombination.
GURT	Genetic use restriction technologies. Mechanisms that prevent or restrict gene flow from GM crops, e.g. GM male sterility.
Haploid	Possessing only one copy of each chromosome. Within higher organisms, only the reproductive cells are haploid, whereas the somatic (body) cells are diploid (two copies of each chromosome) or polyploid (three or more copies of each chromosome - often found in plants).
Homologous recombination	See Recombination.
Homology	Similarity between sequences of DNA or amino acids (that make up proteins) in individuals of the same, or different species.
Horizontal gene flow	See Horizontal gene transfer.
Horizontal gene transfer (HGT)	Non-sexual, non-parental-to-offspring processes by which genetic material can sometimes transfer between organisms with distant genetic relationships.
Hybrids/hybridisation	Offspring of two genetically unlike parents. Crossing of two sexually compatible but genetically different plants.
In silico	In a computer. In the present context, the use of data bases of DNA and protein sequence to help answer biological questions. This is a growing area of biology, as the amount of genomic and proteomic data continue to grow. See bio-informatics.
Interspecific plant competition	Competition between one plant species and another.
Introgression	Introduction of new allele(s) or gene(s) into a population from an exotic source, usually another species. This is achieved by repeated backcrossing of the initial hybrid in order to eliminate all genetic changes except for the desired new gene(s).
Intron	DNA sequence that interrupts the protein-coding sequence of a gene. An intron is transcribed into RNA but is cut out of the message before it is translated into protein.
Invasiveness (or invasive species)	Ability of an organism, particularly an alien species (qv), to spread beyond its presently established site, and become established in new locations.
in vitro	Outside the organism, or in an artificial environment. Applied,

	for example, to cells, tissues or organs cultured in glass or plastic containers.
in vivo	The natural conditions in which organisms reside. Refers to biological processes that take place within a living organism or cell under normal conditions.
Late successional closed vegetation	The endpoint of natural change following disturbance (e.g. forest or heath).
Lepidoptera	Order of insects that includes butterflies and moths.
Linkage drag	When the selection pressure operating for, or against, a trait encoded by a gene(s) is affected by the co-inheritance of linked genes.
Macrophage	Large white blood cells that ingest foreign substances and display on their surfaces antigens that are recognised by other cells of the immune system.
Marker genes	A gene of known function, sequence and/or location, used for marker-assisted selection or for genetic studies. Marker genes conferring traits that are novel to plants are used to identify plants into which transgenic DNA has been successfully introduced e.g. genes encoding resistance to certain antibiotics.
Marker rescue	Restoration of gene function by replacement of a defective gene with a normal one through recombination.
Meiosis	Process of two consecutive cell divisions in the formation of sex cells (gametes).
Metabolomics	The large-scale study of the full complement of secondary metabolites produced by a given species in all its cells, tissues and/ or growth stages.
Microarrays	A large set of DNA molecules immobilized as a compact and orderly pattern of sub-microlitre spots onto a solid matrix (e.g. a glass slide). Used to analyse patterns of gene expression, presence of markers, or nucleotide sequences. The major advantage of microarrays is the extent to which the process of genotyping can be automated, thereby enabling large numbers of individuals to be genetically typed at many loci simultaneously. A similar approach may be used with other immobilised components (e.g. proteins) for other purposes.
Micronutrients	Components of nutrition required in relatively small quantities by organisms, e.g. vitamins or minerals.
Millieumeetlat system	Scoring system is used to evaluate toxicity, mobility and

	persistence of pesticides.
mRNA	Messenger RNA. The RNA molecule resulting from transcription of a protein-encoding gene, following any splicing (removal of introns). The information encoded in the mRNA molecule is translated into a polypeptide (protein) by the ribosomes.
mRNA fingerprinting	Pattern of mRNAs present in an organism under specific conditions.
Mutation breeding	Induction of heritable change(s) in the genetic constitution of a cell through alterations to its DNA, using mutagenic chemicals or radiation. Used in breeding programmes to introduce genetic differences from which new crop phenotypes with desirable traits can be selected. Can cause gross and unpredictable changes to whole chromosomes as well as to specific genetic loci. These smallest changes can involve the substitution, deletion or insertion of a single nucleotide.
Naked DNA	DNA from any source (whether or not created by recombinant DNA techniques) that has been purified and separated from the proteins that normally surround the DNA in a living organism.
Nuclear DNA	DNA organised into chromosomes and which contains most of the genes (typically 25 000 – 50 000) that are largely responsible for the differentiation and activity of the cell. Plastids and mitochondria contain non-nuclear DNA.
Nucleotides	A subunit of DNA or RNA consisting of a nitrogenous base (adenine, guanine, thymine, or cytosine in DNA; adenine, guanine, uracil or cytosine in RNA), a phosphate molecule and a sugar molecule (deoxyribose in DNA and ribose in RNA). Thousands of nucleotides are linked through repeating sugar-phosphate bonds to form a DNA or RNA molecule.
Open reading frames	Abbreviation: ORF. A sequence of nucleotides in a DNA or RNA molecule that has the potential to encode a peptide or protein: comprises a start triplet (ATG), followed by a series of triplets (each of which encodes an amino acid), and ending with a stop codon (TAA, TAG or TGA). The number of ORFs provides an estimate of the number of genes that could be transcribed from the DNA sequence.
Origin of replication	See Replication origin.
Pathogen	Disease-causing organism (generally microbial: bacterial, fungal or viral; but can extend to other organisms, e.g. nematodes).

Pest	An organism that reduces the productivity of a crop e.g. certain insects, birds and nematodes.
PCR	See Polymerase chain reaction.
Phytochemicals	Molecules characteristically found in plants.
Phytoremediation	Biological remediation (restoration) of the environment using plants.
Plasmid	Autonomously replicating extra-chromosomal circular DNA molecule, distinct from the normal bacterial genome and non-essential for cell survival under non-selective conditions. Some plasmids are capable of integrating into the host genome. A number of artificially constructed plasmids are used as gene cloning vectors (vehicles).
Plastid	Plant-specific organelles, such as chloroplasts, which carry their own DNA.
Pleiotropy	The simultaneous effect of a gene on more than one apparently unrelated trait.
Pollination	Part of the process of fertilisation, in which pollen is transferred from an anther (male part) to the stigma (female part) of the same (self-pollination) or a different (cross-pollination) sexually compatible plant.
Polymerase chain reaction	Abbreviation: PCR. A method for dramatically increasing the number of copies of a specific fragment of DNA *in vitro*.
Polyploid	Three or more copies of each chromosome in a cell.
Post-marketing monitoring	The hypothesis-driven, routine collection of information after a product is on the market (i.e. widely available). For example, epidemiological monitoring involves looking for a disease condition, characteristic or state in a population.
Post-marketing surveillance	Surveillance takes a general look at trends. e.g. epidemiological surveillance is the systematic collection, collation, analysis and interpretation of health-related events occurring in populations.
Prokaryotes	Unicellular organism lacking a membrane-bound, structurally discrete nucleus and other subcellular compartments. Bacteria are examples of prokaryotes.
Promoter	A DNA sequence at the start of a gene to which RNA polymerase (an enzyme) will bind and initiates transcription/expression of a gene into messenger (or other)

	RNA. Genomic and subgenomic promoters also exist in RNA viruses where they initiate copying of RNA into RNA.
Protists	A single-celled eukaryote.
Recombinant DNA technology	Set of techniques for manipulating DNA, including: the identification, modification and cloning of genes; the study of the expression of cloned genes; and the production of large quantities of gene products.
Recombinase	Class of enzymes able to alter the arrangement of DNA sequences in a site-specific way.
Recombination	Process by which progeny derive a combination of genes different from that of either parent. In higher organisms such as plants, this can occur by crossing over (breaking during meiosis of one maternal and one paternal chromosome, the exchange of corresponding sections of DNA, and the rejoining of the chromosomes). In lower organisms such as bacteria and viruses, it describes the cutting and rejoining or RNA/DNA template switching, which results in the exchange of fragments of genetic material or information between different organisms. It also describes the transfer of transgenic material between lower organisms and GM plants containing homologous sequences. **Homologous recombination** mediates the transfer or exchange of genetic information between homologous sections of DNA.
Refugia	Area of crops or adjacent land where there is no control of weeds or, more usually, insects, and thus provide a safe haven for them. Refugia can be placed adjacent to conventional crops sprayed with herbicides or insecticides or near GM herbicide-tolerant or insect-resistant crops to reduce the selection pressure on the insects or weeds to evolve resistance and increase local biodiversity. May be accomplished by qv: Countryside Stewardship Schemes, Conservation Headlands and Wildlife strips.
Replication origin	The nucleotide position on a DNA sequence from which DNA synthesis (replication) is initiated.
Reverse transcriptase PCR	Abbreviation: RT-PCR. RNA (mRNA) molecule(s) reverse transcribed into a DNA copy are then amplified using PCR. RT-PCR can be used to identify which genes are being expressed in a cell (i.e. the mRNA population), whereas PCR identifies all of the genes (DNA) that are present.
RNAi	RNA interference.
Satellite RNA	Plant viruses often contain parasites of their own, referred to as

	satellites. Satellite RNAs are dependent on their associated (helper) virus for both replication and encapsidation.
Secondary metabolite profiling	See Metabolomics.
Silencing	Mechanisms in a genome that repress the expression of genes; can be achieved using transgenes. Recent work involves qv RNAi.
Substantial equivalence	Used to structure the comparison of a novel food with its conventional counterpart to identify any compositional differences that then become part of a more focussed safety assessment.
Sulfonyl urea	Herbicides that block the synthesis of essential branched chain amino acids (leucine, isoleucine and valine) by inhibiting the enzyme acetolactate synthase (ALS). For this reason, these chemicals are sometimes referred to as SU/ALS herbicides or ALS herbicides.
Synergism	Phenomenon in which one virus may facilitate replication and/or increase the symptom severity of another co-infecting virus, resulting in more severe disease.
Terminator	DNA sequence just downstream of the coding segment of a gene, which is recognized by RNA polymerase as a signal to stop synthesizing mRNA.
Terminator technology	A type of GURT. Transgenic method that genetically sterilises the progeny of a planted seed.
Tillage	Ploughing or harrowing. Zero-tillage or low-till agricultural practices may be implemented.
Trait	One of the many characteristics that define an organism. The phenotype is a description of one or more traits.
Trans	Spatially separated, e.g. on opposite chromosomes.
Transencapsidation	Complete or partial encapsidation (packaging), of the genome of one virus with the coat protein of another virus.
Transformation	Uptake and integration of DNA in a cell.
Transgene stacking	Accumulation of transgenes conferring different traits in one plant. This can arise intentionally or unintentionally through cross-fertilisation or by the introduction of different traits into a GM plant variety through one or a number of successive transformation events.

Transgenic DNA/ transgene	Isolated sequence of DNA stably inserted into the genome of a recipient organism.
Translation initiation signal/factor	The RNA codon (AUG) that specifies the first amino acid of a polypeptide chain. An assemblage of proteins necessary for the initiation of polypeptide synthesis from mRNA.
Transposon	DNA element that can move from one location in the genome to another, or through an RNA intermediate.
Triazines	Herbicides that inhibit photosynthesis (in particular photosystem II) e.g. atrazine.
Unencapsidated	Viral DNA or RNA not enclosed by a coat protein shell or capsid.
Vector	Small DNA molecule (plasmid, virus, bacteriophage, artificial or cut DNA molecule) that can be used to deliver DNA into a cell. Vectors must be capable of being replicated and contain cloning sites for the introduction of foreign DNA. Vector can also refer to an organism, usually an insect, which carries and transmits pathogens. Also refers to an organism, usually an insect that carries and transmits pathogens/ disease.
Vernalisation	Chilling juvenile plants for a minimum period in order to induce flowering. Some plants (e.g. sugar beet) require vernalisation to flower, but others have no such requirement.
Viroids/virusoids	Unique plant pathogenic agents, composed of infectious single-stranded low molecular weight RNAs, and no coat protein.
Volunteer	Crop plant self-propagated from a previous year's crop (e.g. from seed or tubers).
Wild type	The most frequent allele or genotype found in nature.
Wildlife strips	Edges of fields that are not planted or treated with agrochemicals (part of qv Countryside stewardship scheme).
Zygote	The result of fertilisation between two gametes. It undergoes a cycle of multiple divisions to become an embryo.