

# Glossary of terms

- Accession:** A distinct, uniquely identified sample of seeds, plants, or other germplasm materials that is maintained as an integral part of a germplasm collection.
- Adaptedness:** The degree or capacity of an individual to survive in a local environment and to transmit its genotype to the next generation.
- Additive gene effect:** The effect of an allele expected after it has replaced another allele at a locus.
- Agrobacterium*:** A type of soil-inhabiting bacteria that is capable of introducing DNA from plasmids in the bacteria into the genome of plant cells. Often used in the genetic transformation of plants.
- Allele:** One of several alternate forms (DNA sequences) that resides at the same locus on the chromosome and controls the same phenotype (although with potentially differing effects).
- Allogamy:** Alternative term for cross-pollination.
- Allopolyploid (or allopolyploid):** An individual with somatic cells that contain more than two sets of chromosomes, each of which derives from a different species.
- Amino acid:** A building block of proteins. Each protein consists of a specific sequence of amino acids (with the sequence of amino acids determined by the sequence of the underlying DNA). There are 20 types of amino acid molecules that make up proteins.
- Amphidiploid (or amphiploid):** An allopolyploid with the complete chromosome complements of two diploid species.
- Aneuploid:** An individual with a chromosome number that is not the exact multiple of the basic number for the species.
- Antisense:** The complementary strand of a coding sequence (gene); often an expressed copy of an antisense sequence is transformed into a cell or organism to shut off the expression of the corresponding gene.
- Apomixis:** Asexual reproduction in plants through the formation of seeds without fertilization (agamospermy).
- Asexual reproduction:** The reproduction process that does not involve the union of gametes.
- Autoploid (or autopolyploid):** An individual with more than two complete sets of the basic number of chromosomes for the species.
- Average effect of a gene:** The change in mean value of the population produced by combining a gene with a random sample of gametes from the original population.
- Backcross:** A cross of an  $F_1$  to either parent used to generate it.
- Base collection:** A comprehensive collection of germplasm accessions held for the purpose of long-term conservation.
- Base pair (bp):** Two nitrogenous bases (adenine and thymine or guanine and cytosine) held together by weak bonds. Two strands of DNA are held together in the shape of a double helix by the bonds between base pairs.
- Bioinformatics:** A broad term to describe applications of computer technology and information science to organize, interpret, and predict biological structure and function. Bioinformatics is usually applied in the context of analyzing DNA sequence data.
- Biopharming:** The use of genetically transformed crop plants and livestock animals to produce valuable compounds, especially pharmaceuticals. Also called pharming.
- Bioremediation:** The use of biological organisms to render hazardous wastes non-hazardous or less hazardous.
- Biotechnology:** A set of biological techniques developed through basic research and now applied to research and product development.
- Breeding:** The science and art of manipulating the heredity of an organism for a specific purpose.
- Breeding line:** A genetic group that has been selected and bred for its special combinations of traits.
- Breeding value:** The mean genotypic value or the progeny of an individual expressed as a deviation from the population mean.
- Bt (*Bacillus thuringiensis*):** A naturally occurring bacterium that produces a protein toxic to certain lepidopteran insects.
- Callus:** A cluster of undifferentiated plant cells that have the capacity to regenerate a whole plant in some species.
- Cell:** The fundamental level of structural organization in complex organisms. Cells contain a nucleus (with chromosomes) and cytoplasm with the protein synthesis machinery, bounded by a membrane.
- Cell culture:** A technique for growing cells under laboratory conditions.
- Cell fusion:** The formation of a hybrid cell produced by fusing two different cells.
- Centimorgan (cM):** A unit of measure of recombination frequency. One centimorgan is equal to a 1% chance that a marker at one genetic locus will be separated from a marker at a second locus due to crossing over in a single generation.

- Central dogma:** The underlying model for describing gene structure and function. It states that genes are transcribed in the nucleus into messenger RNA molecules, which are then translated into proteins on ribosomes.
- Certified seed:** The progeny or increase from a breeder or foundation seed and approved by a certifying agency.
- Chimera:** An individual consisting of cells of two or more types.
- Chromosome:** A condensed structure found in the cell nucleus that contains the genes of that cell.
- Clonal propagation:** The reproduction of plants through asexual means, such as cuttings, grafts, or tissue culture.
- Cloning:** Asexually producing multiple copies of genetically identical cells or organisms descended from a common ancestor.
- Codon:** A triplet of nucleotides in a DNA or RNA molecule that codes for one of the 20 amino acids in proteins, or for a signal to start or stop protein production. Each gene that codes for protein is a series of codons that gives the instructions for building that protein.
- Combining ability:** The performance of a line with others in a cross.
- Complementary:** The opposite or “mirror” image of a DNA sequence. A complementary DNA sequence has an A for every T, and a C for every G. Two complementary strands of single-stranded DNA will join to form a double-stranded molecule.
- Complementary DNA (cDNA):** A single-stranded DNA molecule that is complementary to a specific RNA molecule and synthesized from it. Complementary DNAs are important laboratory tools as DNA probes and for isolating and studying individual genes.
- Conserved sequence:** A base sequence in a DNA molecule (or an amino acid sequence in a protein) that has remained essentially unchanged throughout evolution.
- Crossing over:** The breaking during meiosis of one maternal and one paternal chromosome, the exchange of corresponding sections of DNA, and the rejoining of the chromosomes.
- Cultivar:** A product of plant breeding that is released for access to producers.
- Deoxyribonucleic acid (DNA):** 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.
- Diploid:** A full set of genetic material consisting of paired chromosomes, one chromosome from each parental set.
- DNA chip:** A high density array of short DNA molecules bound to a solid surface for use in probing a biological sample to determine gene expression, marker pattern, or nucleotide sequence of DNA/RNA. See also **Microarray**.
- DNA probe:** A single-stranded DNA molecule used in laboratory experiments to detect the presence of a complementary sequence among a mixture of other single-stranded DNA molecules. Also called gene probe.
- DNA profile:** The distinctive pattern of DNA restriction fragments or PCR products that can be used to identify, with great certainty, any person, biological sample from a person, or organism from the environment.
- DNA replication:** The use of existing DNA as a template for the synthesis of new DNA strands. In humans and other eukaryotes, replication occurs in the cell nucleus.
- DNA sequencing:** Determining the order of nucleotides in a specific DNA molecule.
- Domestication:** The process of bringing wild plants under cultivation to produce crops under the supervision of humans.
- Dominant:** A phenotype that is expressed in an organism whose genotype may be either homozygous or heterozygous for the corresponding allele.
- Double helix:** The shape that two linear strands of DNA assume when bonded together.
- Doubled haploid:** An individual that is produced by doubling its gametic ( $n$ ) chromosome number into  $2n$ .
- Electrophoresis:** A method of separating substances, such as DNA fragments, by using an electric field to make them move through a “gel” at rates that correspond to their electric charge and size.
- Embryo rescue:** The removal and culture of an immature embryo to produce a plant, often following a wide cross.
- Enhancement:** The process of improving a germplasm accession by breeding while retaining the important genetic contributions of the accession.
- Enzyme:** A protein that acts as a catalyst, speeding the rate at which a biochemical reaction proceeds but not altering the direction or nature of the reaction.
- Epistasis:** The interaction of genes at different loci; the situation in which one gene affects the expression of another.
- Eukaryote:** Cell or organism with a membrane-bound, structurally discrete nucleus and other well-developed subcellular compartments.
- Functional genomics:** The field of study that attempts to determine the function of all genes (and gene products), largely based on knowing the entire DNA sequence of an organism.
- Gamete:** Mature male or female reproductive cell (sperm or ovum) with a haploid set of chromosomes).
- Gene:** The fundamental unit of heredity; a bundle of information for a specific biological structure or function.
- Gene cloning:** Isolating a gene and making many copies of it by inserting the DNA sequence into a vector, then into a cell, and allowing the cell to reproduce and make many copies of the gene.
- Gene expression:** The process in which a cell produces the protein, and thus the characteristic, that is specified by a gene’s nucleotide sequence.

- Gene library:** A collection of DNA fragments (carried on vector molecules) that, taken together, represents the total DNA of a certain cell type or organism.
- Gene regulation:** The process of controlling the synthesis or suppression of gene products in specific cells or tissues.
- Gene splicing:** Joining pieces of DNA from different sources using recombinant DNA technology.
- Genetic code:** The language in which DNA's instructions are written. The code consists of triplets of nucleotides (codons), with each triplet corresponding to one amino acid in a protein structure or to a signal to start or stop protein production.
- Genetic engineering:** The manipulation of genes, composed of DNA, to create heritable changes in biological organisms and products that are useful to people, living things, or the environment.
- Genetic erosion:** The loss of genetic diversity caused by either natural or manmade processes.
- Genetic marker:** A genetic factor that can be identified and thus acts to determine the presence of genes or traits linked with it but not easily identified.
- Genetic stocks:** Accessions that typically possess one or more special genetic traits that make them of interest for research.
- Genetic vulnerability:** The condition that results when a crop or a plant species is genetically and uniformly susceptible to a pest, pathogen, or environmental hazard.
- Genetically modified (GM) organism:** An organism whose genetic makeup has been changed by any method including natural processes, genetic engineering, cloning, mutagenesis, or others.
- Genetics:** Study of the patterns of inheritance of specific traits.
- Genome:** The complete set of chromosomes found in each cell nucleus of an individual.
- Genomics:** The field of study that seeks to understand the structure and function of all genes in an organism based on knowing the organism's entire DNA sequence, with an extensive reliance on powerful computer technologies.
- Genotype:** The specific combination of alleles present at a single locus in the genome.
- Germ cells:** The sex cell(s) of an organism (sperm or egg, pollen or ovum). They differ from other cells (somatic) in that they contain only half the usual number of chromosomes. Germ cells fuse during fertilization to begin the next generation.
- Germplasm:** The sum total of all hereditary material in a single (interbreeding) species.
- Green Revolution:** An aggressive effort between 1950 and 1975 where agricultural scientists applied modern principles of genetics and breeding to improve crops grown primarily in less developed countries.
- Haploid:** A cell or organism with a single genome.
- Heterozygosity:** The presence of different alleles at one or more loci on homologous chromosomes.
- Heterozygous:** Situation where the two alleles at a specific genetic locus are not the same.
- Homologous:** Stretches of DNA that are very similar in sequence, so similar that they tend to stick together in hybridization experiments. Homologous can also be used to indicate related genes in separate organisms controlling similar phenotypes.
- Homologous chromosomes:** A pair of chromosomes containing the same linear gene sequences, each derived from one parent.
- Homozygous:** Situation where the two alleles at a specific genetic locus are identical to one another.
- Hybrid:** The progeny of a cross between two different species, races, cultivars, or breeding lines.
- Hybridization (or crossing):** The process of pollen transfer from the anther of the flower of one plant to the stigma of the flower of a different plant for the purpose of gene transfer to produce an offspring (hybrid) with a mixed parental genotype.
- Hybridization:** Bringing complementary single strands of nucleic acids together so that they stick and form a double strand. Hybridization is used in conjunction with DNA and RNA probes to detect the presence or absence of specific complementary nucleic acid sequences.
- In vitro:** Performed in a test tube or other laboratory apparatus.
- In vivo:** In the living organism.
- Inbreeding:** The breeding of individuals that are related.
- Isoenzyme (isozyme):** Different chemical forms of the same enzyme that can generally be distinguished from one another by electrophoresis.
- Landrace:** A population of plants, typically genetically heterogeneous, commonly developed in traditional agriculture from many years of farmer-directed selection, and which is specifically adapted to local conditions.
- Linkage:** The proximity of two or more markers (e.g., genes, RFLP markers) on a chromosome.
- Linkage map:** A map of the relative positions of genetic loci on a chromosome, determined on the basis of how often the loci are inherited together. Distance is measured in centimorgans (cM).
- Locus:** The position on a chromosome where the gene for a particular trait resides; a locus may be occupied by any one of several alleles (variants) for a given gene.
- Meiosis:** The process of two consecutive cell divisions in the diploid progenitors of sex cells. Meiosis results in four rather than two daughter cells, each with a haploid set of chromosomes.
- Messenger RNA (mRNA):** The ribonucleic acid molecule that transmits genetic information from the nucleus to the cytoplasm, where it directs protein synthesis.
- Microarray:** A large set of cloned DNA molecules spotted onto a solid matrix (such as a microscope slide) for use in probing a biological sample to determine the gene expression, marker pattern, or nucleotide sequence of DNA/RNA.
- Microsatellite:** A repeated motif of nucleotides, usually only two or three bases in length, where the number of repeats frequently differs between different members of a species.

- Mitosis:** The process of nuclear division in cells which produces daughter cells that are genetically identical to each other and to the parent cell.
- Molecular marker:** An identifiable physical location on a chromosome (e.g., restriction enzyme cutting site, gene) whose inheritance can be monitored.
- Multiline:** A mixture of isolines, each of which is different for a single gene conditioning different forms of the same trait.
- Mutagen:** A substance that induces mutations.
- Mutation:** A permanent change in the genetic material involving either a physical alteration in the chromosome or a biochemical change in the underlying DNA molecule.
- Nitrogenous base:** A nitrogen-containing molecule having the chemical properties of a base.
- Nucleic acid:** A large molecule composed of nucleotide subunits.
- Nucleotide:** A subunit of DNA or RNA consisting of a nitrogenous base (adenine, guanine, thymine, or cytosine in DNA).
- Nucleus:** Membrane-bound structure in the cell that contains the chromosomes (genetic material). The nucleus divides whenever the cell divides.
- Pathogen:** A specific biological causative agent of disease in plants or animals.
- Pedigree:** A record of the ancestry of an individual of family.
- Phenotype:** A biological characteristic or trait possessed by an organism that results from the expression of a specific gene.
- Physical map:** A map of the locations of identifiable landmarks on DNA (e.g., restriction enzyme cutting sites, genes), regardless of inheritance. Distance is measured in base pairs.
- Plasmid:** A small, self-replicating molecule of DNA that is separate from the main chromosome. Because plasmids are easily moved from cell to cell or to the test tube, scientists often cleave them with restriction enzymes and insert foreign DNA, and then transfer the recombinant DNA plasmid molecule (as a vector) into other cells.
- Pollination:** The transfer of pollen from the anthers to the stigma of a flower.
- Polymerase chain reaction (PCR):** A technique to amplify a specific DNA sequence *in vitro* using a DNA replicating enzyme, specific oligonucleotide primers, and repeated cycles of heating and cooling. PCR often amplifies the starting material many thousands or millions of times.
- Polymorphism:** The simultaneous occurrence of two or more distinct forms in a population in a frequency that cannot be accounted for by the balance of mutation and selection.
- Polyploidy:** An individual with more than two sets of chromosomes characteristic of the species.
- Primer:** Short pre-existing polynucleotide chain to which new deoxyribonucleotides can be added by DNA polymerase.
- Probe:** Single-stranded DNA or RNA molecules of a specific base sequence, labeled either radioactively or immunologically, that are used to detect the complementary base sequence by hybridization.
- Prokaryotes:** Organisms whose genetic material is not enclosed by a nucleus.
- Promoter:** A DNA sequence preceding a gene that contains regulatory sequences controlling the rate of RNA transcription of that gene. In effect, promoters control when and in which cells a given gene will be expressed.
- Protein:** A molecule composed of amino acids arranged in a special order determined by the genetic code. Proteins are required for the structure and function of all living organisms.
- Pure line:** The progeny of a single homozygous individual produced by repeated selfing.
- Recessive:** A phenotype that is expressed in organisms only if it is homozygous for the corresponding allele.
- Recombinant DNA:** A hybrid DNA molecule produced in the laboratory by joining pieces of DNA from different sources.
- Recombinant DNA technologies:** Procedures used to join together DNA segments in a cell-free system (an environment outside a cell or organism). Under appropriate conditions, a recombinant DNA molecule can enter a cell and replicate there, either autonomously or after it has become integrated into a cellular chromosome.
- Recombination:** The process by which progeny derive a combination of genes different from that of either parent. In higher organisms, this can occur by crossing over.
- Recurrent selection:** A breeding method whereby plants are repeatedly selected and intercrossed to increase the frequency of favorable alleles.
- Regeneration:** The process of growing an entire plant from a single cell or group of cells.
- Reporter gene:** A gene sequence that is easily observed when it is expressed in a given tissue or at a certain stage of development.
- Restriction enzyme:** An enzyme that recognizes a specific nucleotide base sequence (usually four to six base pairs in length) in a double-stranded DNA molecule and cuts both strands of the DNA molecule at every place where this sequence occurs.
- Restriction fragment length polymorphism (RFLP):** The presence of two or more variants in the size of DNA fragments produced by a restriction enzyme. These different sized fragments result from an inherited variation in the presence of a restriction enzyme's target sequence. RFLPs are used for gene mapping and DNA profiling.
- Ribonucleic acid (RNA):** A molecule that translates the instructions encoded in DNA to build proteins.
- Ribosomes:** Small cellular components composed of specialized ribosomal RNA and protein; site of protein synthesis.
- Selection (field):** The process of discriminating among genetic variability to advance a fraction to the next generation or breeding cycle.
- Selection (*in vitro*):** A method to retain specific cells (or clones of cells) expressing a specific trait, such as antibiotic or herbicide resistance, while killing off all other cells that do not express that trait.

**Somatic cell:** Cells in the body that are not involved in sexual reproduction (that is, not germ cells).

**Southern blotting:** Transfer by absorption of DNA fragments separated in electrophoretic gels to membrane filters for the detection of specific base sequences by radiolabeled complementary probes.

**Tissue culture:** Growing cells, tissues, or tissue fragments (from complex, multicellular organisms) on a nutrient medium in a dish, test tube, or flask.

**Totipotent:** A cell that is capable of regenerating an entire adult organism by itself.

**Trait:** A distinguishing characteristic or quality of an organism.

**Transcription:** The transfer of information from specific

sequences in a DNA molecule to produce new strands of messenger RNA, which then carry this information from the nucleus to the cytoplasm (where the messenger RNA is translated into protein).

**Transformation:** Introduction of an exogenous DNA molecule into a cell, causing it to acquire a new phenotype (trait).

**Transgenic:** An organism that has been transformed with a foreign DNA sequence.

**Translation:** Synthesis of protein using information contained in a messenger RNA molecule.

**Vector:** A type of DNA molecule, usually a plasmid or virus, that is used to move recombinant DNA molecules from one cell to another.