Glossary

Abaxial located on the side furthest from the axis, e.g., the lower side of a leaf

Abiotic not directly caused or induced by organisms

Absorbance fraction of radiation incident on a surface that is absorbed

Abscisic acid, ABA *phytohormone* (15-carbon compound that resembles the terminal portion of some *carotenoid* molecules) involved in *stress* responses; its name is derived from its involvement in leaf abscission; it reduces cell expansion and causes *stomatal* closure

Acclimation Increased tolerance to *stress* and/or improved plant performance as a result of structural and physiological adjustment by individual plants to specific environmental conditions (see also *plasticity*)

Accumulation build-up of storage products resulting from an excess of supply over *demand*; also termed interim deposition

Acidifuge avoiding acid soils; with a preference for a substrate that does not have a low pH

Active (or reactive) oxygen species (ROS) hydrogen peroxide (H_2O_2), superoxide radicals ($O_2^{\cdot -}$), and hydroxyl radicals ($OH^{\cdot}$), the compounds can cause cell damage, but are also involved in *signal transduction*

Active transport transport of molecules across a *membrane* against an electrochemical gradient through expenditure of metabolic energy

Acyanogenic not releasing cyanide

Adaptation evolutionary adjustment of the genetic basis of a trait that enhances the performance in a specific environment

Adaxial located on the side nearest to the axis, e.g., the upper side of a leaf

Adsorption binding of ions or molecules to a surface (e.g., of a soil particle or a root)

Advection net horizontal transfer of gases

Aerenchyma tissue with large air spaces that facilitate transport of gases in plants

Agglutinin synonym for *lectin*

Albedo fraction of the incident short-wave radiation reflected by a surface (typically plant cover or bare soil or rock)

Alkaloid *secondary plant compound* (often toxic), characterized by its alkaline reaction and a heterocyclic ring (e.g., nicotine, caffeine, and colchicine)

Allelochemical *secondary metabolite*, released by living plants or decomposing plant *litter* that (either negatively or positively) affects other organisms

Allelopathy suppression of growth of one plant by another of a different species due to the release of toxic substances

Allocation proportional distribution of products or newly acquired resources among different organs or functions in a plant

Alternative oxidase *mitochondria*l enzyme catalyzing the transfer of electrons from ubiquinol (the reduced form of ubiquinone) to O_2

Alternative pathway (of respiration) nonphosphorylating electron-transport pathway in the inner *membrane* of plant *mitochondria*, transporting electrons from ubiquinol (the reduced form of ubiquinone) to O_2, catalyzed by the *alternative oxidase*

Amphistomatous with *stomata* at both the *adaxial* (upper) and *abaxial* (lower) sides of a leaf

Amylase *starch*-hydrolyzing enzyme

Anion negatively charged ion

Anisotropic not equal in all directions; for example, the longitudinal walls of anisotropic cells have different chemical and biophysical properties from those of the radial walls

Anoxia absence of oxygen in (part of) a plant's environment

Annual species with a life cycle of less then a year; the short life cycle can be environmentally or developmentally determined

Antiport Co-transport of one compound in one direction coupled to transport of another compound (mostly H^+) in the opposite direction

Apatite $Ca_5(PO_4)_3(OH,F)$; it accounts for 95% of the total P in igneous rock, and it constitutes a major substrate for weathering, which releases inorganic phosphate for plants and microorganisms

Apoenzyme Enzymatic protein that requires a *coenzyme* to function

Apoplast (=apoplasm) space in a plant's tissue outside the space enclosed by plasma *membrane*s (*symplast*); it includes the *cell wall*s and the dead tissues of the xylem

Apoplastic (=apoplasmic) phloem loading transport of assimilates from *mesophyll* to the sieve tubes of the *phloem* occurring partly through the *apoplast*

Aquaporin water-channel protein in a *membrane*

Arbuscular mycorrhiza a type of *mycorrhiza* that forms arbuscules (highly branched exchange structures) within cortical cells of the root

Assimilation incorporation of an inorganic resource (e.g., CO_2 or NH_4^+) into organic compounds (in the case of CO_2 assimilation also used as a synonym for *photosynthesis*)

ATPase enzyme catalyzing the *hydrolysis* of ATP, producing ADP and P_i; the energy from this hydrolysis is used to pump protons across a membrane (e.g., plasma *membrane*, tonoplast), thus generating an electrochemical gradient

ATPase/ATP synthase enzyme complex in the inner *membrane* of *mitochondria* and the *thylakoid membrane* of *chloroplasts* catalyzing the formation of ATP, driven by the *proton-motive force* (pmf)

Autotoxicity deleterious effect of a chemical compound released by plants of the same species

Autotrophic growth increment in mass, volume, length, or area of plants or parts thereof which depend on carbon fixed in *photosynthesis* by the growing organism itself (see also *heterotrophic growth*)

Autotrophic respiration *respiration* by autotrophic plants and their associated *mycorrhizas* and *symbiotic N_2-fixing* structures (see also *heterotrophic respiration*)

Auxin *phytohormone* (indole-3-acetic acid) involved in growth promotion and meristem *differentiation* ; the name literally means enhancing and is derived from its growth-promoting action; there are also synthetic auxins

Avoidance plant *strategy* of resisting adverse conditions by preventing deleterious effects of these conditions, e.g., winter seed *dormancy*

Bacteroid state of *rhizobia* after they have penetrated the root and the *symbiosis* has been established

Bark Tissue with both a protective (outer bark) and transport (inner bark) function; inner bark consists of secondary *phloem* that carries sugars, amino acids, and minerals from a *source* to a *sink*

Biennial species whose individuals typically live for two growing seasons, vegetative growth in the first year and continued growth and seed production in the second year; several species known as biennials can, however, have an extended vegetative period (*monocarpic perennial*), others are strictly biennial

Biomass Mass of plants (and other living organisms)

Biomass density dry mass of plant tissue per unit of fresh mass or volume (in the first case, the presence of intercellular air spaces is not taken into account)

Biotic caused or induced by organisms

Biotic filter *biotic* interactions, which eliminate species that would otherwise have survived the *abiotic* environment of a site

Blue-light receptors two classes of *photoreceptor*s, cryptochromes and phototropins, that absorb in the blue region of the spectrum; the receptors are involved, e.g., in the perception of irradiance and the directional component of light and thus affect *photomorphogenesis*

Bolting rapid extension of the flowering stalk

Boundary layer thin layer of air, water, or soil around the leaf or root with reduced mass

transport and increased reliance on *diffusion* for transport processes, conditions differ from those further away

Boundary layer conductance/resistance *conductance/resistance* for transport of CO_2, water vapor, or heat between the leaf surface and the atmosphere measured across the *boundary layer*

Bowen ratio the ratio between sensible heat loss and heat loss due to *transpiration*

Bulk density mass of dry soil per unit volume

Bulk soil soil beyond the immediate influence of plant roots (see *boundary layer*)

Bundle sheath cells cells surrounding the vascular bundle of a leaf

C_3 photosynthesis photosynthetic pathway in which the first step of CO_2 *assimilation* is the *carboxylation* of ribulose 1,5-bisphosphate (RuBP) by *Rubisco*; the first product is phosphoglyceric acid (PGA), a three-carbon intermediate

C_4 photosynthesis photosynthetic pathway in which the first step of CO_2 *assimilation* is the *carboxylation* of phosphoenolpyruvate (PEP) by PEP carboxylase during the day; the first product is oxaloacetic acid (OAA) a four-carbon intermediate

Calcicole species with a preference for calcareous or high-pH soils

Calcifuge species that typically occupies acidic soils and is absent from calcareous or high-pH soils

Callose b-(1-3)-polymer of glucose, synthesized in sieve tube elements of the *phloem* in response to damage, sealing of the sieve tubes; callose is also produced in other cells upon microbial attack, thus providing a physical barrier

Calmodulin ubiquitous Ca^{2+}-binding protein whose binding to other proteins depends on the intracellular Ca^{2+} concentration; component of *signal-transduction pathways*

Calvin cycle (Calvin—Benson cycle, carbon reduction cycle) pathway of photosynthetic CO_2 *assimilation* beginning with *carboxylation* of RuBP by *Rubisco*

Canopy conductance/resistance *conductance/resistance* for transport of CO_2, water vapor, or heat between the plant canopy and the atmosphere measured across the *boundary layer* of the canopy

Carbamylation reaction between CO_2 and an amino group; in many species, *Rubisco* is activated by carbamylation, catalyzed by *Rubisco activase*

Carbonic anhydrase enzyme catalyzing the interconversion of HCO_3^- and CO_2

Carboxylate organic acid minus its protons

Carboxylation binding of a CO_2 molecule to a CO_2-acceptor molecule

Carboxylation efficiency initial slope of the CO_2-response curve of *photosynthesis*

Carotenoid accessory photosynthetic pigment; carotenoids of the *xanthophyll cycle* play a role in dissipation of excess energy

Carrier protein involved in ion transport across a *membrane*

Caruncle (=*strophiole*) an outgrowth of a seed coat, near the *hilum*; preformed weak site in the seed coat

Casparian band/strip waxy suberin impregnation on the radial and transverse wall of *endodermis* and *exodermis* cells that renders the wall impermeable to water

Cation positively charged ion

Cavitation breakage of a water column in a xylem conduit due to air seeding

Cellulose structural polymer of glucose; major component of plant *cell walls* giving tensile strength

Cell wall structural matrix surrounding plant cells; part of the *apoplast*

Cell-wall elasticity reversible change in *cell-wall* dimensions

Cell-wall extensibility irreversible extension of *cell walls*, due to structural changes

Chaperones group of *stress proteins* that are encoded by a multigene family in the nucleus; chaperones bind to and stabilize an otherwise unstable conformation and, thus, mediate the correct assembly of other proteins

Chelate compound that combines reversibly, usually with high affinity, with a metal ion (e.g., iron, copper, or calcium)

Chelator *cation*-binding organic molecule, such as citric acid, malic acid, and *phytosiderophores*

Chemiosmotic model theory accounting for the synthesis of ATP driven by a *proton-motive force*

Chilling injury/tolerance injury caused by exposure of plants or tissues to low temperatures ($> 0^oC$); *tolerance* of such temperatures

Chitin polymer of *N*-acetylglucosamine; component of the exoskeleton of arthropods and the *cell wall* of fungi, but **not** of plants

Chitinase chitin-hydrolyzing enzyme that breaks down fungal *cell walls*

Chlorenchyma tissue containing *chloroplasts*

Chlorophyll green pigment in the photosynthetic *membrane* (*thylakoid*) involved in light capture as the first step in *photosynthesis*

Chloroplast organelle (plastid) in which *photosynthesis* occurs

Chromophore light-absorbing constituent of a macromolecule (*photoreceptor*) that is responsible for light absorption

Citric acid cycle *Tricarboxylic acid cycle*

Climax species species that are confined to later stages of succession in a plant community; as opposite to *pioneer*

Clonal growth asexual production of physiologically complete plants; a form of vegetative reproduction

Cluster roots bottle-brush-like or Christmas-tree-like structures in roots with a dense packing of root hairs, releasing *carboxylates* into the *rhizosphere*, thus solubilizing poorly available nutrients (e.g., phosphate) in the soil

CO_2-compensation point CO_2 concentration at which the rate of CO_2 *assimilation* by *photosynthesis* is balanced by the rate of CO_2 production by *respiration*

Coenzyme a nonproteinaceous organic substance that combines with a specific protein, the *apoenzyme*

Coevolution evolution of two (or more) species of which at least one depends on the other as a result of selection by mutual interactions

Cofactor inorganic ion or *coenzyme* required for an enzyme's activity

Cohesion theory accounts for the ascent of sap in the xylem due to the cohesive forces between ascending water molecules under high tension and the adhesive forces between water and capillaries in the wall of xylem conduits

Companion cell cell type in the *phloem*, adjacent to sieve element, involved in phloem loading

Compartmentation restriction of compounds or processes to specific cells, or parts of a cell, such as storage of *secondary metabolite*s in vacuoles

Compatible interaction response of a susceptible host to a virulent pathogen; positive interaction between pollen and pistil allowing guidance of the sperm cells toward the ovule

Compatible solute solute that has no deleterious effect on metabolism at high concentrations

Compensation point conditions (temperature, $[CO_2]$, light) where net CO_2 exchange by a leaf or plant is zero (i.e., *photosynthesis* equals *respiration*)

Competition interaction among organisms (of the same or different species), which utilize common resources that are in short supply (resource competition), or which harm one another in the process of seeking a resource, even if the resource is not in short supply (interference competition)

Competitive ability probability of winning in *competition* with another species in a particular environment

Conductance flux per unit driving force (e.g., concentration gradient); inverse of resistance

Constitutive produced in constant amount (as opposed to regulated) (e.g., genes can be expressed constitutively)

Constitutive defense background level of plant defense in the absence of induction by herbivores or pathogens

Construction cost carbon and nutrients required to produce new tissue, including the *respiration* associated with the biosynthetic pathways

Contractile roots mature roots that decrease in length, while increasing in diameter, thus pulling the plant deeper in the soil, as in geophytes

Convective heat transfer direct transfer of heat (e.g., from leaf to air) and further transport by turbulent movement

Convergent evolution process whereby, in organisms that are not closely related, similar traits evolve independently as a result of *adaptation* to similar environments or ecological niches

Coupling factor *ATP synthetase* in thylakoid *membrane* of *chloroplasts* and inner membrane of *mitochondria*

Crassulacean acid metabolism photosynthetic pathway in which the first step of CO_2 *assimilation* is the *carboxylation* of phosphoenolpyruvate (PEP) by PEP carboxylase; the first product is oxaloacetic acid (OAA)—a four-carbon intermediate; in contrast to C_4 *photosynthesis*, in CAM *photosynthesis*, the CO_2 assimilation occurs predominantly during the night with open *stomata*

Crista fold of the inner *mitochondrial membrane*

Critical daylength length of the night triggering flowering

Cross-resistance The phenomenon in which an organism that has acquired *resistance* to one pathogen or herbivore through direct exposure simultaneously has acquired resistance to other pathogens or herbivores to which it has not been exposed. Cross-resistance arises because the biological mechanism of resistance is the same and arises through identical genetic mutations

Cross-talk Communication between different *signal transduction pathways*

Cryptochrome *blue-light-absorbing photoreceptor*, involved in *photomorphogenesis*

Cuticle waxy coating of external plant surfaces

Cuticular conductance/resistance *conductance/resistance* for transport of CO_2 or water vapor movement through the *cuticle*

Cutin waxy substances that are part of the *cuticle*; polymer consisting of many long-chain hydroxy fatty acids that are attached to each other by ester linkages, forming a rigid three-dimensional network

Cyanogenic releasing cyanide

Cytochrome colored, heme-containing protein that transfers electrons in the respiratory and photosynthetic electron transport chain

Cytochrome oxidase *mitochondrial* enzyme catalyzing the final step in the transfer of electrons from organic molecules to O_2

Cytochrome P450 element in the synthesis of anthocyanins and in the detoxification of *xenobiotics*

Cytochrome pathway phosphorylating electron-transport pathway in the inner *membrane* of plant *mitochondria*, transporting electrons from NAD(P)H or $FADH_2$ to O_2, with *cytochrome oxidase* being the terminal oxidase

Cytokinin(s) a class of *phytohormones*, involved, e.g., in the delay of leaf *senescence*, cell division, cell extension, release of *dormancy* of buds, and *chloroplast differentiation*

Cytoplasm contents of a cell that are contained within its plasma *membrane*, but outside the vacuole and the nucleus

Cytosol cellular matrix in which *cytoplasmic* organelles are suspended

Dark reaction carbon fixation during *photosynthesis*; does not directly require light but uses the products of the light reaction (see also *Calvin cycle*)

Dark respiration processes in the *cytosol*, *plastids*, and *mitochondria* that break down carbon-containing compounds and generate ATP; it produces CO_2 and consumes O_2 when aerobic; when referring to gas exchange, all decarboxylation and O_2-consuming processes are included, apart form *photorespiration*

Deciduous Having leaves that fall off or are shed seasonally in response to specific environmental cues, such as that occurs during or preceding unfavorable seasons (see also *evergreen*)

Decomposition breakdown of organic matter through fragmentation, microbial and chemical alteration, and leaching

Defense compound *secondary metabolite* conferring some degree of protection from pathogens or herbivores

Dehydrins immunologically distinct family of proteins (*Lea* D11 family) that typically accumulate in plants during the late stages of embryogenesis or in response to any environmental influence that has a dehydrating effect

Delayed greening pattern of leaf development typical of shade-tolerant rain-forest species; leaves are initially white, red, blue, or light-green during the stage of leaf expansion, reflecting their low concentration of *chlorophyll* and associated photosynthetic proteins

Demand requirement; the term is used in the context of the control of the rate of a process (e.g., nutrient uptake, CO_2 *assimilation*) by the amount needed

Demand function dependence of net CO_2 *assimilation* rate on the intercellular or *chloroplast* CO_2 concentration, irrespective of the supply of CO_2 at ambient atmospheric CO_2 concentration

Denitrification microbial conversion of nitrate to gaseous nitrogen (N_2 and N_2O); nitrate is used as an electron acceptor

Desiccation tolerance tolerance of extreme water *stress*, with recovery of normal rates of metabolism shortly following rehydration

Desorption the reverse of *adsorption*

Diaheliotropism solar tracking in which the leaf or flower remains perpendicular to incident radiation

Differentiation cellular specialization

Diffuse porous wood in which wide and narrow xylem *vessel*s are randomly distributed throughout each annual growth ring

Diffusion net movement of a substance along a concentration gradient due to random kinetic activity of molecules

Diffusion shell zone of nutrient depletion around individual roots caused by active nutrient uptake at the root surface and *diffusion* to the root from the surrounding soil (see also *boundary layer*)

Disulfide bond covalent linkage between two sulfhydryl groups on cysteines

Divergent evolution naturally selected changes in related species that once shared a common characteristic, but have come to be different during the course of their evolution

Dormancy state of seeds or buds that fail to grow when exposed to an environment that would otherwise have favored *germination* or growth

Dorsiventral having structurally different upper and lower surfaces (see also *isobilateral*)

Down-regulation decrease of the normal rate of a process, sometimes involving suppression of

genes encoding enzymes involved in that process

Ecophysiology study of the physiological mechanisms by which organisms cope with their environment

Ecosystem ecological system that consists of all the organisms in an area and the physical environment with which they interact

Ecosystem respiration sum of plant and *heterotrophic respiration*

Ecotone environmental gradient

Ecotype genetically differentiated population that is restricted to a specific habitat

Ectomycorrhiza *mycorrhizal* association in some trees in which a large part of the fungal tissue is found outside the root

Efficiency rate of a process per unit plant resource

Elastic modulus force needed to achieve a certain reversible change in cell volume

Embolism see *cavitation*

Emissivity coefficient that describes the thermal radiation emitted by a body at a particular temperature relative to the radiation emitted by an ideal black body

Endocytosis uptake of material into a cell by an invagination of the plasma *membrane* and its internalization in a *membrane*-bound vesicle

Endodermis innermost layer of root cortical cells that surrounds the vascular tissue; these cells are surrounded by a suberized Casparian strip that blocks *apoplastic* transport

Ephemeral short lived

Epidermis outermost cell layer of an organ, typically covered by a *cuticle*

Epinasty downward bending of a plant organ; see also *hyponasty*

Epiphyte plant living on another plant as a support, without a *symbiotic* or parasitic association

Ethylene ethene (C_2H_4); a gaseous *phytohormone*; ethylene is, e.g., a signaling compound when roots are exposed to *hypoxia*, inducing *aerenchyma* formation and petiole extension

Evapotranspiration water loss from an *ecosystem* by *transpiration* and surface evaporation

Evergreen Bearing foliage that persists and remains throughout the year, as opposed to *deciduous*

Exclusion prevention of net entry of a molecule; it may be due to low permeability for a molecule or to its *extrusion*

Excretion active secretion of compounds (e.g., salt from leaves)

Exodermis outer cortical cell layer in roots, immediately below the *epidermis*; these cells are surrounded by a suberized Casparian strip that blocks *apoplastic* transport

Expansin cell-wall enzyme involved in cell expansion

Extensin rigid cell-wall glycoprotein, rich in hydroxyproline, that represents 5—10% of the dry weight of most primary *cell walls*; significant component of the secondary walls of sclerenchyma cells

Extinction coefficient coefficient describing the exponential decrease in irradiance through a compartment that absorbs radiation (e.g., a leaf, a canopy, or a pigment in solution)

Extrusion ion transport from root cells to the external medium, dependent on respiratory metabolism

Exudate compounds released by plants (mostly by roots); also xylem or *phloem* fluid that appears when the stem is severed from the roots or a cut is made in the stem

Exudation release of *exudates*, or the appearance of fluid from cut roots or stems

Facilitation positive effect of one plant on another

Facultative CAM plants plants that photosynthesize by *Crassulacean Acid Metabolism* (CAM) during dry periods and by C_3 or C_4 *photosynthesis* at other times

Feedback influence of a product of a later step in a chain on an earlier step; fluctuations in rate of the process or concentration of metabolites are minimized with negative feedbacks or amplified with positive feedbacks

Feedforward response in which the rate of a process is affected before any deleterious effect of that process has occurred; for example, the decline in *stomatal conductance* before the *water potential* in leaf cells has been affected

Fermentation anaerobic conversion of glucose to organic acids or alcohol

Field capacity water content that a soil can hold against the force of gravity

Flavanols, flavines, flavones families of *flavonoids*

Flavonoid one of the largest classes of plant *phenolics*, in which two aromatic rings are connected by a carbon link to a third phenyl ring; representatives of this class play a role in the *symbiosis* between *rhizobia* and legumes, as *phytoalexins*, as *antioxidants*, in the colors of flowers and as *defense compounds*

Fluence response response to a dosage of light

Fluorescence *photons* emitted when excited electrons return to the ground state

Frost hardening *acclimation* of a plant as a result of exposure to low temperatures that make it *frost tolerant* (e.g., hardening in autumn)

Frost hardiness/tolerance physiological condition that allows exposure to subzero temperatures without cellular damage

Geotropism growth response of plant organs with respect to gravity

Germination (of a seed) emergence of a part of the embryo through the seed coat, normally the radicle

Gibberellin class of *phytohormones*; the first gibberellin was found in the fungus *Gibberella fujikora*, from which these phytohormones derive their name; gibberellins are involved, e.g., in the promotion of seed *germination*, stem extension, and *bolting*

Giga- prefix denoting 10^9

Glass Solidlike liquid with an extremely high viscosity; examples of a glass are macaroni and "glass" as we know it from everyday life (which is **not** a solid, but a fluid, as apparent from the gradually changing properties of glass when it gets old); glass formation, rather than the formation of ice crystals, is essential to prevent damage incurred by the formation of ice crystals

Glaucousness shiny appearance (of leaves), due to the presence of specific wax compounds

Glucoside (or glycoside) compound in which a side chain is attached to glucose by an acetal bond

Glucosinolate secondary sulfur-containing metabolite in Brassicaceae (cabbage family) which gives these plants a distinct sharp smell and taste

Glutathione tripeptide (γ-glutamyl-cysteinyl-glycine) that acts as a reducing agent, protecting the cell against oxidative *stress*, and guards against chemical toxicity, via modification of (modified) *xenobiotics*

Glycolipid *membrane* lipid molecule with a short carbohydrate chain attached to a hydrophobic tail

Glycolysis ubiquitous metabolic pathway in the *cytosol* in which sugars are metabolized to pyruvate and/or malate with production of ATP and NADH (when pyruvate is the end product)

Glycophyte species restricted to nonsaline soils

Glycoprotein any protein with one or more covalently linked oligosaccharide chains

Glycoside (or glucoside) compound in which a side chain is attached to a sugar by an acetal bond

G protein intracellular *membrane*-associated proteins activated by several receptors

Grana stacked region of photosynthetic *membranes* (*thylakoids*) in *chloroplasts* that contains *photosystem* II with its *light-harvesting complex*

Gross photosynthesis amount of carbon dioxide assimilated in *chloroplasts*; it is measured as net *photosynthesis* plus dark *respiration*

Growth increment in mass, volume, length, or area of plants or parts thereof

Growth respiration amount of *respiration* required per unit increment in *biomass*; it is **not** a rate

Guard cells specialized *epidermal* cells that surround the *stomata* and regulate the size of the *stomatal pore*

Guttation water *exuded* by leaves due to *root pressure*

Halophyte species that typically grows on saline soils

Hartig net hyphal network of *ectomycorrhizal* fungi that have penetrated intercellularly into the cortex of a higher plant

Haustorium organ that functions in attachment, penetration, and transfer of water and solutes from a host to a parasitic plant

Heartwood central mass of xylem in tree trunks not functioning in water transport; it often contains substances that prevent decay and has a darker color than the surrounding *sapwood*

Heat-shock protein protein produced upon heat or other *stresses*

Heavy metal metal with a mass density exceeding 5 g mL^{-1}

Heliotropism solar tracking; movement of a leaf or flower that follows the angle of incident radiation

Heme cyclic organic molecule that contains an iron atom in the center which binds O_2 in leghemoglobin and carries an electron in *cytochromes*

Hemicellulose heterogeneous mixture of neutral and acidic polysaccharides, which consist predominantly of galacturonic acid and some rhamnose; these *cell-wall* polymers coat the surface of *cellulose* microfibrils and run parallel to them

Heterodimer protein complex composed of two different polypeptide chains

Heterotrophic growth *growth* of plants or parts thereof which depend on carbon supplied by another organism or organ of the plant (see also *autotrophic growth*)

Heterotrophic respiration *respiration* by nonautotrophic organisms (see also *autotrophic respiration*)

Hexokinase enzyme catalyzing the *phosphorylation* of hexose sugars while hydrolyzing ATP; a specific hexokinase is involved in *sugar sensing*

Hilum Seed scar where the funiculus (the stalk of the ovule) was once attached

Historical filter historical factors that prevent a species from arriving at a site

Homeostasis tendency to maintain constant internal conditions in the face of a varying external environment

Homodimer protein complex composed of two identical polypeptide chains

Hormone organic compound produced in one part of a plant and transported to another, where it acts in low concentrations to control processes (*phytohormone*)

Humic substances high-molecular-weight polymers with abundant *phenolic* rings and variable side chains found in *humus*

Humus amorphous soil organic matter

Hydraulic lift upward movement of water from deep moist soils to dry surface soils through roots along a *water potential* gradient

Hydrenchyma water-storing tissue; during dehydration of a plant, water is predominantly lost from the cells in the hydrenchyma, while other cells lose relatively less water

Hydrolysis cleavage of a covalent bond with accompanying addition of water, —H being added to one product and —OH to the other

Hydrophyte plant that grows partly or wholly in water, whether rooted in the mud, as a lotus, or floating without anchorage, as the water hyacinth

Hygrophyte species typically occurring on permanently moist sites; see also *mesophyte* and *xerophyte*

Hydrotropism morphogenetic response (of roots) to a moisture gradient

Hyponasty Upward bending of a plant organ (see also *epinasty*)

Hypostomatous with *stomates* at the *abaxial* (lower) side of the leaf only

Hypoxia low oxygen concentration in (part of) a plant's environment

Immobilization nutrient absorption from the soil solution and sequestering by soil microorganisms

Incompatible interaction response of a resistant host to a virulent pathogen; interaction between pollen and pistil preventing sperm cells from reaching the ovule

Induced defense increased levels of plant *secondary metabolites* in response to herbivory or pathogen attack

Infiltration movement of water into the soil

Infrared radiation radiation with wavelengths between approximately 740 nm and 1 mm; *short-wave infrared* is emitted by the sun (<3 μm), *long-wave infrared* is emitted at Earth temperatures (>3 μm)

Interception acquisition of nutrients by roots as a result of growing through soil; the nutrients contained in the soil volume displaced by the growing root; precipitation water remaining in a plant canopy that does not reach the soil

Intercrop one crop plant grown in combination with at least one other crop on the same plot at the same time (e.g., an annual crop grown between trees)

Interference competition *competition* mediated by production of *allelochemicals* by a plant

Intermediary cell *phloem* cell in plants with a *symplastic* pathway of *phloem* loading; sucrose moves from the *mesophyll* into these cells, where it is processed to form oligosaccharides that move to the sieve tube

Internal conductance/resistance *conductance/resistance* for transport of CO_2 between the substomatal spaces and its *carboxylation* at the site of *Rubisco* in the *chloroplast*

Ion channel/ion-selective channel pore in a *membrane* made by a protein, through which ions enter single file; channels are specific and either open or closed, depending on *membrane* potential or the presence of regulatory molecules

Isobilateral having structurally similar upper and lower surfaces (see also *dorsiventral*)

Isohydric maintaining a constant water status

Isoprene small unsaturated hydrocarbon, containing five carbon atoms (2-methyl-1,3-butadiene); volatile compound, synthesized from mevalonic acid and precursor of other isoprenoids; can be produced in large amounts by photosynthesizing tissue at high temperatures

Isotope discrimination alteration of the isotopic composition of an element via processes of *diffusion*, evaporation, and chemical transformation,

due to small differences in physical and chemical properties of isotopes; typically discrimination against the rare (heavy) isotope

Isotope effect end result of various processes that have different rate constants for different isotopes of the same element

Isotope fractionation process that occurs when different isotopes of the same element have different rate constants for the same reaction or process, or chain of reactions or processes

Isotropic similar in all directions

Jasmonic acid *secondary plant compound* [3-oxo-2-(2′-*cis*-pentenyl)-cyclopropane-1-acetic acid], named after its scent from jasmine; *stress* signaling molecule in plants as well as **between** plants

Juvenile phase stage in the life cycle of a plant between the *seedling* and *reproductive* phases; the vegetative phase in herbaceous plants; typically a period of rapid *biomass* accumulation

k_{cat} catalytic constant of an enzyme: rate of the catalyzed reaction expressed in moles per mole catalytic sites of an enzyme (rather than per unit protein, as in V_{max})

K_i concentration of an inhibitor that reduces the activity of an enzyme to half the rate of that in the absence of that inhibitor

K_m substrate concentration at which a reaction proceeds at half the maximum rate

K strategy suite of traits that enable a plant to persist in a climax community

Kranz anatomy specialized leaf anatomy of C_4 species with photosynthetic *bundle sheath cells* surrounding vascular bundles

Krebs cycle *tricarboxylic acid cycle*; metabolic pathway in the *matrix* of the *mitochondrion* oxidizing acetyl groups derived from imported substrates to CO_2 and H_2O

Latent heat energy consumed or released by evaporation or condensation, respectively, of water (enthalpy of transformation); it results in respectively loss and gain of heat

Law of the minimum obsolete concept that plant growth is always limited at any point in time by one single resource; it is not valid in this strict sense

Leaf area index total leaf area per unit area of ground

Leaf area ratio (LAR) ratio between total leaf area and total plant *biomass*

Leaf conductance/resistance *conductance/resistance* for transport of CO_2 or H_2O (vapor) of a leaf (it includes the conductance/resistance for the *stomatal* and the *boundary layer* pathways in the case of H_2O, and additionally for the *internal mesophyll* pathway in the case of CO_2)

Leaf-mass density leaf dry mass per unit of fresh mass or volume (in the first case, the presence of intercellular air spaces is not taken into account)

Leaf mass per unit leaf area (LMA) leaf mass expressed per unit leaf area

Leaf mass ratio (LMR), or leaf mass fraction (LMF) ratio of leaf and whole plant *biomass*

Leaf turnover replacement of *senescing* leaves by new ones, not accounting for a change in leaf area

Lectin protein with noncatalytic sugar-binding domains; lectins are involved in defense and cellular interactions

Leghemoglobin Hemoglobin-like protein in nodules that associates with O_2 by means of a bound *heme* group

Light-compensation point irradiance level at which the rate of CO_2 *assimilation* in *photosynthesis* is balanced by the rate of CO_2 production in *respiration*

Light-harvesting complex complex of molecules of *chlorophyll*, accessory pigments, and proteins in the *thylakoid membrane* that absorbs quanta and transfers the excitation energy to the reaction center of one of the *photosystems*

Light reaction transfer of energy from absorbed light to ATP and NADP(H) in the photosynthetic *membrane* (*thylakoid*)

Light saturation (of photosynthesis) range of irradiances over which the rate of CO_2 *assimilation* is maximal and insensitive to level of irradiance

Lignan *phenolic* compound with antifungal, antifeeding, and antitumor activity; minor component in most plants and tissues, but quantitatively more important in the wood of some tree species (e.g., redwood)

Lignin large amorphous poly*phenolic* polymer that confers woodiness to stems

Litter dead plant material that is sufficiently intact to be recognizable

Litter quality chemical properties of *litter* that determine its susceptibility to *decomposition*, largely determined by concentrations of *secondary metabolite*s and nutrients

Lockhart equation equation that describes cell expansion in terms of *turgor* pressure and *cell-wall* properties

Long-day plant plant whose flowering is induced by exposure to short nights

Long-wave infrared radiation with wavelengths larger then approximately 3 μm emitted at Earth temperatures

Lumen cavity, such as the space surrounded by the *thylakoid membrane* or the trap of *Utricularia* surrounded by cells

Luxury consumption uptake of nutrients above the rate that enhances plant growth rate

Lysigenous aerenchyma Gas-transport tissue in plants that is formed from spatially selective death of expanded cells (see also *schizogenous aerenchyma*)

Macronutrients inorganic nutrients that a plant requires in relatively large quantities: K, Ca, Mg, N, S, P

Macrosymbiont larger partner (i.e., higher plant) in a *symbiosis* with a microorganism

Maintenance respiration *respiration* required to maintain the status quo of plant tissues

Mass flow movement of substances at equal rates as the fluid or gas in which they occur (e.g., transport of solutes in flowing water and CO_2 in flowing air)

Matric potential component of the *water potential* that is due to the interaction of water with capillaries in large molecules (e.g., clay particles in soil)

Matrix a substance in which other structures or organelles are embedded; used for the compartment inside *chloroplast*s or *mitochondria*, not including the *membrane* system; also used for the substance in which cell-wall macromolecules are embedded

Mean residence time (of a nutrient in a plant) - time a nutrient remains in the plant, between uptake by the roots and loss (e.g., due to leaf shedding, consumption by a herbivore)

Mega- prefix (M) denoting 10^6

Membrane (*phospholipid*) bilayer that surrounds cells (*plasmalemma*), cell organelles, and other cell compartments

Membrane channel transmembrane protein complex that allows inorganic ions, small molecules, or water to move passively cross the lipid bilayer of a *membrane*

Membrane fluidity loose term to describe the extent of disorder and the molecular motion within a lipid bilayer; fluidity is the inverse of viscosity

Mesophyll photosynthetic cells in a leaf; in a *dorsiventral* leaf often differentiated in *palisade* and *spongy parenchyma* cells

Mesophyte plant that typically grows without severe moisture *stress*es (see also *hygrophyte* and *xerophyte*)

Metallophyte species that typically grows in areas with high concentrations of certain heavy metals in the soil

Micro- prefix (μ) denoting 10^{-6}

Microclimate local atmospheric zone where the climate differs from the surrounding atmosphere. (e.g., near a leaf, within a forest and near a body of water)

Microfibril structural component in *cell walls*, consisting of bundles of around 50 *cellulose* molecules, that provides the tensile strength of the wall

Metallothionein low-molecular-mass metal-binding protein

Micronutrients inorganic nutrients that a plant requires in relatively small quantities: Mo, Cu, Zn, Fe, Mn, B, Cl (see *macronutrients*)

Microsymbiont smaller partner (i.e., microorganism) in a *symbiosis* with a higher plant

Mimicry resemblance of an organism to another organism or object in the environment, evolved to deceive predators, prey, pollinators, etc.

Mineralization breakdown of organic matter releasing inorganic nutrients in the process

Mistletoe xylem-tapping stem parasite

Mitochondrion organelle in which part of the respiratory process (*tricarboxylic acid cycle*, respiratory electron transport) occurs

Monocarpic life cycle that ends after a single seed production event; the plant flowers only once during its lifetime, which can be after several years or even decades of vegetative growth

Mycorrhiza (plural is mycorrhizae or mycorrhizas) structure arising from a symbiotic association between a mycorrhizal fungus and the root of a higher plant (from the Greek words for fungus and root, respectively)

Mycorrhizal dependency (of plant growth) the ratio of dry mass of mycorrhizal plants to that of plants of the same genotype grown without mycorrhizal fungus under the same environmental conditions

Nano- prefix (n) denoting 10^{-9}

Net assimilation rate (NAR) rate of plant *biomass* increment per unit leaf area; synonym is *unit leaf rate* (ULR)

Net ecosystem carbon balance (NECB) net change in *ecosystem* carbon content due to all processes, including *photosynthesis*, *respiration*, loss of *biomass*, leaching, and lateral movements and transfers

Net ecosystem production (NEP) organic carbon accumulation that equals gross *photosynthesis* minus *ecosystem respiration* or *net primary production* minus *heterotrophic respiration*

Net primary production (NPP) quantity of new plant material produced annually per unit ground area including lost plant parts; equals *gross photosynthesis* minus *autotrophic respiration*

Nitrification microbial process that transforms ammonia, via nitrite, into nitrate

Nitrogen assimilation incorporation of inorganic nitrogen (nitrate, ammonium) into organic compounds

Nitrogen fixation reduction of dinitrogen gas to ammonium by specialized microorganisms

Nod factor product of *nod* genes required for successful *nodulation* in the legume—*rhizobium symbiosis*

***Nod* gene** *rhizobial* gene involved in the process of *nodulation*

Nodulation formation of nodules in symbiotic N_2-fixing plants

Nodulins class of plant proteins that are synthesized in legumes upon infection by *rhizobia*

Normalized difference vegetation index (NDVI) greenness index used to estimate above-ground net primary production from satellites, based on *reflectance* in the visible and near *infrared*

Nuclear magnetic resonance (NMR) spectroscopy technique used to make a spectrum of molecules with a permanent magnetic moment, due to nuclear spin; the spectra are made in a strong magnetic field that lines up the nuclear spin in all the molecules; it can, for instance, be used to measure the pH in different cellular compartments in vivo because the site of the peak in a spectrum depends on the pH around the molecule

Nutrient productivity rate of plant *biomass* increment per unit nutrient in the plant

Nutrient resorption withdrawal of nutrients from a plant part during *senescence* before shedding

Nutrient-use efficiency growth per unit of absorbed plant nutrient which equals nutrient productivity times mean residence time of the nutrient; *ecosystem* nutrient-use efficiency is the ratio of *litter*fall mass to *litter*fall nutrient content (i.e., the amount of *litter* produced per unit of nutrient lost in *senescence*)

Opportunity costs diminished growth resulting from diversion of resources from alternative functions that might have yielded greater growth

Osmoregulation adjustment of the concentration of osmotic solutes in plant cells in response to changes in soil *water potential*

Osmosensor system involved in sensing a change in the concentration of solutes in cells; osmosensors were first extensively studied in yeasts and subsequently also identified in plants

Osmotic potential component of the *water potential* that is due to the presence of osmotic solutes; its magnitude depends on solute concentration

Oxidative pentose phosphate pathway metabolic pathway that oxidizes glucose and generates NADPH for biosynthesis

Oxidative phosphorylation formation of ATP (from ADP and P_i) coupled to a respiratory electron-transport chain in *mitochondria* and driven by a proton-motive force

Oxygenation the binding of O_2 to a substrate, without changing the redox state of O (e.g., ribulose-1,5-bisphosphate by *Rubisco*); it also refers to the addition of O_2 to a medium (e.g., water)

Palisade mesophyll transversally oriented elongated photosynthetic cells at the *adaxial* side of a *dorsiventral* leaf

PAR *photosynthetically active radiation* (400—700 nm)

Paraheliotropism leaf movement that positions the leaf more or less parallel to the incident radiation throughout the day

Parent material rock and other substrates that generate soils through weathering

Pectin *cell-wall* polymer rich in galacturonic acid

Perennial species whose individuals typically live more than 2 years; the length of the life cycle can be indeterminate or end after a single seed production event (*monocarpic*)

Peribacteroid membrane plant-derived *membrane* that surrounds one or more bacteroids in root nodules

Pericarp matured ovulary wall in a seed

Pericycle layer of outermost stelar cells, adjacent to the *endodermis*

Permanent wilting point soil *water potential* at which a plant can no longer absorb water from the soil; it is species specific but is generally taken to be —1.5 MPa

Peta- prefix (P) denoting 10^{15}

Phenol compound that contains a hydroxyl group on an aromatic ring

Phenolics aromatic hydrocarbons, many of which have antimicrobial and anti-herbivore properties

Phenology time course of periodic developmental events in an organism that are typically seasonal (e.g., budbreak or flowering)

Phenotypic plasticity range of variation of a trait in a genotype as a result of growth in contrasting environmental conditions

Phenylalanine ammonia lyase enzyme that catalyzes the fist step in the conversion of the amino acid phenylalanine into *phenolics*

Phloem long-distance transport system in plants for *mass flow* of carbohydrates and other solutes

Phosphatase enzyme hydrolyzing organic phosphate-containing molecules

Phospholipid major category of *membrane* lipids, generally composed of two fatty acids linked through glycerol phosphate to one of a variety of polar groups

Phosphorylation process involving the covalent binding of a phosphate molecule; many enzymes change their catalytic properties when phosphorylated

Photodamage/photodestruction damage to/destruction of components of the photosynthetic apparatus as a result of exposure to high irradiance, frequently in combination with other *stress* factors; the result is *photoinhibition*

Photoinhibition decline in *photosynthetic efficiency* upon exposure to high irradiance; the decline can be transient (less than 24 hours), which is related to protection of the photosynthetic apparatus, or it can be longer lasting, which implies *photodamage*

Photomorphogenesis Plant development affected by light; generally under control of *photoreceptors*

Photon discrete unit of light that describes its particle-like properties (quantum); light also has wavelike properties

Photon flux density (PFD) A measure of the level of irradiance in the (near) visible spectral region; it is expressed as *photon*s incident on a (horizontal) plane per unit of time; photosynthetic *photon* flux density (PPFD) refers to the *photosynthetically active* part of the spectrum; see also *quantum flux density*

Photoperiod length of the daylight period each day

Photoperiodic responding to the length of the night

Photoreceptor A protein with chromophore that absorbs light in a specific spectral region; it is typically the start of a *signal-transduction pathway* leading to *photomorphogenetic* events

Photorespiration production of CO_2 in the metabolic pathway that metabolizes the products of the *oxygenation* reaction catalyzed by *Rubisco*; see also *respiration*

Photosynthesis process in which light energy is used to reduce CO_2 to organic compounds; occurs in *chloroplast*s in higher plants and algae

Photosynthetic efficiency *efficiency* of the use of light for *photosynthesis* (*quantum yield*); mostly used in conjunction with *chlorophyll fluorescence*

Photosynthetic nitrogen-use efficiency rate of *photosynthesis* expressed per unit (organic) nitrogen in the photosynthesizing tissue

Photosynthetic quotient ratio between CO_2 uptake and O_2 release in *photosynthesis*

Photosynthetic water-use efficiency ratio between photosynthetic carbon gain and *transpiration*al water loss

Photosynthetically active radiation (PAR) radiation used to drive *photosynthesis* (400—700 nm); the spectral region is similar to that of visible light, but the spectral sensitivity is different from that of the human eye

Photosystem unit comprising pigments and proteins where the excitation energy derived from absorbed *photon*s is transferred to an electron; there are two types of photosystems (I and II) that are embedded in the photosynthetic *membrane* (*thylakoid*)

Phototropism growth of plant organs in response to the directional component of light perceived by the *blue-light photoreceptor* phototropin

Phreatophyte plant species that accesses deep layers of water

Phyllosphere immediate surroundings of a leaf

Phylogenetic constraint genetic constitution of a population or taxon that restricts evolutionary change; it can prevent the development of particular traits

Physiological filter physiological limitations due to intolerance of the physical environment, which prevent survivorship of plant species that arrive at a site

Phytate calcium salt of *myo*-inositol hexakisphosphate; organic P-storage compound in seeds and *endodermis* of some plant species and major fraction of organic P in soils

Phytoalexin plant defense compound against microorganism, whose synthesis is triggered by components of microbial origin

Phytoanticipin *constitutive*ly produced plant *defense compound* against microorganism

Phytochelatin sulfur-rich peptide which binds (heavy) metals

Phytochrome *photoreceptor* absorbing red or far-red radiation (depending on its configuration); this pigment is involved in the perception of the presence of light, light quality, and daylength

Phytohormone plant compound produced in one part of the plant and having its effect in another part at minute concentrations (nanomolar and picomolar range)

Phytomining Extracting naturally occurring metals from soils, by utilizing the uptake capacity of plants that accumulate these metals

Phytoremediation use of green plants to remove, contain, or render harmless environmental contaminants

Phytosiderophore iron-chelating organic molecule in grasses

Pico- prefix (p) denoting 10^{-12}

Pioneer species that is a major component of a vegetation at early stages of *succession*; used in contrast to *climax species*

Pit narrow channel through the thick secondary walls of *vessel* elements in xylem

Pit membrane relatively thin structure in each *pit* which is formed from the primary *cell wall* and consists of a dense network of hydrophilic *cellulose* polymers

Plasmalemma plasma *membrane*; external membrane surrounding the *cytoplasm*

Plasmodesma(ta) minute *membrane*-lined channels that traverse the plant *cell wall* to provide a *cytoplasm*ic pathway for transport of substances between adjacent cells

Plasmolysis separation of the *cytoplasm* from the *cell wall* due to water loss; only happens in water, not in air

Plasticity the ability of an organism to adjust depending on the external environment

Pneumatophore specialized portion of the root that emerges from water-logged soils, believed to be used for gas exchange

Poikilohydric plants or plant parts (seeds, pollen) that can dry out without losing their capacity to function upon rehydration

Post-illumination CO_2 fixation CO_2 fixation that occurs briefly after a light pulse

ppb part per billion; 1 nmol mol^{-1}; 1 ng g^{-1}; nl l^{-1} (not an acceptable SI unit)

ppm part per million; 1 μmol mol^{-1}; 1 μg g^{-1}; μl l^{-1} (not an acceptable SI unit)

Pressure chamber chamber in which a plant or part thereof can be pressurized; it is, among others, a part of the equipment used to determine the *water potential* in the xylem of plant stems

Pressure potential pressure component of the *water potential*; it is positive in nonplasmolyzed living plant cells (*turgor*) and negative in the xylem of transpiring plants (suction)

Pressure probe microcapillary that is injected in a living cell to measure cell *turgor*

Protease/proteinase protein-hydrolyzing enzyme

Protein turnover breakdown and synthesis of proteins that does not account for a change in protein concentration

Proteoid root (=cluster root) cluster root; a short-lived dense package of root hairs that exudes nutrient solubilizing compounds; the name stems from the family of the Proteaceae

Protocarnivory capability of plants to digest arthropods or other organic items that are trapped on sticky surfaces or in "tank" traps and absorb the breakdown products of the trapped material

Proton co-transport transport mechanism that allows movement of a compound against the electrochemical gradient for that molecule, using the *proton-motive force*

Proton-motive force driving force across cell *membrane*s due to a membrane potential and/or proton gradient

Protoplasmic streaming flow of the *cytoplasm*, mediated by the cytoskeleton

Protoplast cell *membrane* with *cytoplasm* and cell organelles inside; it is isolated after enzymatic removal of the *cell wall*

Pulvinus "joint" in a petiole that allows the movement of a leaf, due to transport of ions between cells in the pulvinus, followed by changes in *turgor* (e.g., in many legumes)

Q_{10} change in rate of a reaction in response to a 10°C change in temperature

Qualitative defense compound highly toxic secondary plant metabolite that protects against attack by herbivores at low concentration

Qualitative long-day plant plant that will not flower unless the length of the night gets below a critical value

Qualitative short-day plant plant that will not flower unless the length of the night gets above a critical value

Quantitative defense compound secondary plant metabolite that gives some protection against attack against a broad range of herbivores when present in large amounts

Quantitative long-day plant plant whose flower induction is promoted by exposure to short nights

Quantitative short-day plant plant whose flower induction is promoted by exposure to long nights

Quantum flux density a measure of the level of irradiance; it is expressed as quanta incident on a (horizontal) plane per unit of time; see also *photon flux density*

Quantum yield moles of CO_2 fixed or O_2 evolved in *photosynthesis*, or electrons transported in the photosynthetic *membrane*, per mole of quanta absorbed; in the context of gas exchange often restricted to the linear, light-limited part of the *photosynthesis*—irradiance curve; when measuring chlorophyll fluorescence, it refers to the full range of photosynthetic irradiance

Recalcitrant organic matter soil organic matter that takes a long time to be decomposed

Recalcitrant seeds seeds that do not tolerate desiccation and are consequently difficult to store for longer periods; they typically germinate shortly after dispersal without first going through a phase of *dormancy*

Receptor protein with a high affinity and specificity for a signaling molecule (e.g., a *phytohormone*), which is the start of a *signal-transduction pathway*

Reductive pentose phosphate pathway metabolic pathway that utilizes NADPH produced in the light reaction of *photosynthesis* and produces triose-phosphate

Reflectance fraction of radiation incident on a surface that is reflected (e.g., a leaf, or the Earth surface)

Relative humidity water vapor concentration of air relative to the maximum water vapor concentration at that temperature

Relative water content water content of a plant tissue relative to the water content at full hydration

Reserve formation build-up of storage products that result from diversion of plant resources to storage from alternative *allocations*, such as growth

Resistance (against stress) plant capacity to minimize the impact of *stress* factors in the environment, either by the presence of tolerance mechanisms or by *avoidance* of the stress

Resorption translocation of nutrients and soluble organic compounds from senescing tissues prior to abscission

Resource competition use of the same pool of growth-limiting resources by two or more plants

Respiratory quotient ratio between CO_2 release and O_2 consumption in *dark respiration*

Resurrection plant plant that withstands complete dehydration and resumes functioning upon rehydration

Rhizobia collective term for bacteria that fix N_2 in *symbiosis* with legumes or *Parasponia* of the genera *Rhizobium*, *Bradyrhizobium, Sinorhizobium, Mesorhizobium*, and *Azorhizobium*

Rhizosphere zone of soil influenced by the presence of a root

Ring porous wood in which xylem *vessel*s produced early in the growing season are longer and wider than those produced in late wood, adding to the distinction of annual growth rings

Rock phosphate Inorganic phosphate compound with very low solubility

Root density total root length per unit soil volume

Root-mass density see *biomass density*

Root-mass ratio (RMR) ratio between root *biomass* and total plant biomass, synonym is root mass fraction (RMF)

Root pressure positive *water potential* in the xylem due to ion transport into the xylem of roots and subsequent osmotic uptake of water

Root shoot ratio ratio between root and shoot *biomass*

Root turnover replacement of (old) roots by new ones, not accounting for a change in the total amount of roots

Roughness unevenness of a surface that creates turbulence and enhances convective exchange between the surface and the atmosphere

Rubisco ribulose-1,5-bisphosphate carboxylase/oxygenase; enzyme catalyzing the primary step in the Calvin-cycle, the attachment of CO_2 to the CO_2-acceptor molecule ribulose 1,5-bisphosphate (RuBP); also catalyzes the *oxygenation* of RuBP

Rubisco activase protein catalyzing the carbamylation of *Rubisco* that regulates its activity; chaperone protein protecting the catalytic sites of Rubisco at extreme temperatures and in darkness

Ruderal species species that flourish on disturbed sites and complete their life cycle relatively rapidly

Runoff gravitational water loss from an *ecosystem*; the difference between precipitation and evapotranspiration (surface and groundwater runoff)

Saline soils soils with high salt concentration

Salt gland group of cells involved in salt *excretion*

Saponin secondary plant compound with soap-like properties

Sapwood most recent wood in the xylem of a tree trunk, with open xylem conduits that still function in water transport; it has often a lighter color than the innermost *heartwood*

Scarification breaking, scratching, or softening the seed coat to allow moisture penetration

Schizogenous aerenchyma Gas-transport tissue in plants that is the outcome of highly regulated and species-specific patterns of cell separation and differential cell expansion that creates spaces between cells (see also *lysigenous aerenchyma*)

Sclerenchyma tissue that can consist of two types of cells: sclereids and fibers, which both have thick secondary walls and are frequently dead at maturity

Scleromorph containing a relatively large amount of *sclerenchyma*

Sclerophyllous leaves that are *scleromorph*; they are thick, tough and have a thick *cuticle*

Secondary metabolites compounds produced by plants that are not essential for normal growth and development; they are frequently involved in the interaction with a plant's *biotic* and *abiotic* environment

Seedling phase recently germinated plants that still have their cotyledons attached

Self-thinning reduction in plant density due to increased mortality as a result of *competition*

Senescence programmed series of metabolic events that involve metabolic breakdown of cellular constituents and transport of the breakdown products out of the senescing organ that ultimately dies

Serotinous state of cones on a tree that remain closed with release of seeds delayed or occurring gradually

Serpentine soil soils that naturally contain high levels of various heavy metals and magnesium, but low concentrations of calcium, nitrogen, and phosphate

Short-day plant plants whose flowering is induced by exposure to long nights

Signal-transduction pathway chain of events by which a chemical messenger (e.g., a *phytohormone* or other signaling molecule) or physical (e.g., radiation) signal is sensed and relayed into a chain of molecular events that lead to a response; it can operate at the cellular or whole-plant level, involving long-distance transport of the signal

Sink part of the plant that shows a net import of a compound (e.g., a root is a sink for carbohydrates and a leaf is a sink for inorganic nutrients); see also *source*

Soil texture particle size distribution in a soil, e.g., the relative proportions of sand, silt, and clay

Solar tracking movement of a leaf or flower that positions this organ at a more or less constant angle relative to the incident radiation throughout the entire day

Source part of a plant that shows a net export of a compound (e.g., a leaf is a source for carbohydrates and a root is a source for inorganic nutrients); see also *sink*

Specific leaf area (SLA) leaf area per unit leaf dry mass

Specific leaf mass leaf dry mass per unit leaf area (LMA)

Specific root length (SRL) root length per unit root dry mass

Spongy mesophyll loosely packed photosynthetic cells at the *abaxial* side of a *dorsiventral* leaf

Stomata structures in the leaf *epidermis* formed by specialized epidermal cells; mostly the term refers to the pores, as well as to the stomatal apparatus

Stomatal pore opening in the leaf *epidermis* between two guard cells of *stomata*

Starch polymer of glucose; storage compound in plastids

Stomatal conductance/resistance *conductance/resistance* for transport of CO_2 or water vapor through the stomata

Storage build-up of a metabolically inactive pool of compounds that can subsequently serve to support growth or other physiological functions; see *reserve formation*

Strategy complex suite of traits allowing *adaptation* to a particular environment

Stratification breaking of seed *dormancy* by exposure of moist seeds to low temperatures

Stress environmental factor that reduces plant performance

Stress protein protein that is produced only or in greater quantities upon exposure to *stress*

Stress response the immediate detrimental effect of *stress* on a plant process causing reduced plant performance

Stroma *matrix* within the *chloroplast* containing Calvin-cycle enzymes and in which the *thylakoid membrane* system is suspended

Strophiole (=caruncle) an outgrowth of a seed coat, near the *hilum*; preformed weak site in the seed coat that allows entry of water when sufficiently weathered

Suberin polymer containing long-chain acids, hydroxy acids, alcohols, dicarboxylic acid, and *phenol*s; the exact structure is not fully understood; cell-wall component in many locations (e.g., *Casparian strip*, corky periderm)

Subsidiary cell epidermal cell type around many stomata, located distally and laterally to a guard cell

Succession directional change in plant species composition resulting from biotically driven changes in resource supply

Succulence thick fleshy state of herbaceous tissues due to high water content; it is quantified as the volume of water in the leaf at a *relative water content* of 100% divided by the leaf area

Succulent plant with tissue of high degree of *succulence*

Sugar sensing the perception of internal sugar concentrations that is at the start of a *signal-transduction pathway*

Summer annual species whose seeds germinate after winter and completes its life cycle before the start of the next winter

Sunfleck short period of high irradiance that interrupts the background of low diffuse radiation in and under leaf canopies caused by direct sunlight that penetrates small holes in the canopy

Supercooling refers to the noncrystalline state of water at sub-zero temperatures

Supply function equation describing CO_2 *diffusion* from the atmosphere into the leaf, supplying substrate for *photosynthesis*

Symbiosis intimate association between two organisms of different species (in this text, the term is used when both symbionts derive a long-term selective advantage)

Symbiosome *membrane*-surrounded space containing one or more *rhizobia* in an infected cell of a root nodule in a legume

Symplast space comprising all the cells of a plant's tissues connected by plasmodesmata and surrounded by a plasma *membrane*

Symplastic phloem loading occurs in plants in which photosynthates moves from the *cytoplasm* of the *mesophyll* cells of the leaves, via *plasmodesmata*, to intermediary cells; after chemical transformation into oligosaccharides, these move, again via plasmodesmata, to the sieve tubes

Symport Co-transport of one compound in one direction coupled to transport of another compound (mostly H^+) in the same (uniport) or opposite (*antiport*) direction

Systemic resistance *resistance* that is induced by a herbivore or a microorganism at a location that differs from the plant part that has been primarily affected; the organisms that induce the resistance may be parasitic or have a growth-promoting effect

Tannin class of protein-precipitating polymeric *phenolic* secondary plant compound; typically a *quantitative defense compound*

TCA cycle *Tricarboxylic acid cycle*

Terpenoid class of *secondary plant compounds* containing C and H, produced from the precursor mevalonic acid

Testa seed coat

Thermogenic respiration *respiration* that increases the temperature of an organ, such a the flowers of *Arum* lilies

Thigmomorphogenesis altered growth of plant organs in response to a physical force (touch, wind, vibrations, rain, turbulent water flow)

Thylakoid photosynthetic *membrane* suspended in the *stroma* in *chloroplast*s; it encloses a lumen and contains the photosynthetic pigments, electron-transport chain components and *ATP-synthase*

Tissue-mass density dry mass per unit volume of a tissue

Tissue tension result of differences in *turgor* and/or *cell-wall* elasticity between different cells in a tissue or organ; the tension is relaxed when the organ is cut, resulting in deformation; tissue tension plays an important role in the closing mechanism of the carnivorous Venus fly trap (*Dionaea*)

Tolerance endurance of unfavorable environmental conditions

Tracheid cell type in the xylem

Trade-off balancing of investment in mutually exclusive traits (e.g., protective structures vs. photosynthetic machinery in leaves)

Transfer cell cell involved in transport that has a proliferation of the plasma *membrane* causing surface enlargement (e.g., in the *phloem* of plants using the *apoplast*ic *phloem*-loading pathway, in the *epidermis* of aquatic plants using bicarbonate)

Translocation transport of solutes through the *phloem*

Transmittance fraction of radiation incident on a body that passes through the body; mostly used with reference to leaves

Transpiration water loss from leaves or whole plants due to evaporation from within a leaf or other plant parts

Tricarboxylic acid cycle (TCA cycle) conversion of malate or pyruvate to CO_2 within the *mitochondria*

Trichome epidermal hair on a leaf or stem

Trypsin protein-hydrolyzing enzyme (in animals)

Turgor positive hydrostatic pressure in live plant cells

Uncoupler chemical compound that enhances the *membrane conductance* for protons and so uncouples electron transport from *phosphorylation*

Unit leaf rate (ULR) synonym for *net assimilation rate (NAR)*

Up-regulation increase in the normal rate of a process, sometimes involving increased transcription of genes encoding enzymes involved in that process

V_{max} substrate-saturated rate of a chemical conversion catalyzed by an enzyme (expressed per unit protein, rather than per mole catalytic sites as in k_{cat})

Vacuole *membrane*-bound cell compartment filled with water and solutes; among others used for storage of sugars, nutrients, and *secondary metabolite*s

Vapor pressure deficit (VPD) difference in actual vapor pressure and the vapor pressure in air of the same temperature and pressure that is saturated with water vapor

Vapor pressure difference (Δw) difference in vapor pressure between the intercellular spaces and the atmosphere

Vegetative reproduction asexual reproduction of plants through detachment of a part that develops into a complete plant; clonal growth

Vegetative storage protein proteins accumulating in vegetative plant parts (leaves and hypocotyls) at a high supply of nitrogen (e.g., in *Glycine max*)

Vernalization induction of flowering by exposure to low temperatures (from the Latin word ver = spring)

Vessel water-conducting element of the xylem

Viscoelastic creep mixture of viscous and elastic processes during *cell-wall* expansion; also unsavory character met in dark alleys

Viviparous seeds seeds that germinate prior to abscission from the maternal plant (e.g., mangrove species)

Wall loosening refers to the process during which covalent or noncovalent bonds between *cellulose* microfibrils and other macromolecules are broken, so that the cell under *turgor* can expand

Water channel pore for water transport in *membrane*s consisting of a specialized protein (*aquaporin*); water moves single file

Water potential chemical potential of water divided by the molar volume of water, relative to that of pure water at standard temperature and pressure

Water status loose term referring to aspects of the plant's *relative water content*, *turgor*, *water potential*, etc.

Water stress *stress* due to shortage of water

Water-use efficiency ratio between the gain of (above-ground) *biomass* in growth or CO_2 in *photosynthesis* and *transpiration*al water loss

Wilting point *water potential* at which *turgor* pressure is zero

Winter annual species whose seeds germinate before or in winter and completes its life cycle before the start of the next summer; typically found in Mediterranean-type climates

Xanthophyll cycle chemical transformations of a number of carotenoid molecules in the *chloroplast* that avoid serious damage by excess radiation

Xenobiotic potentially toxic chemical that is found in an organism where it is normally not occurring; can be restricted to synthetic compounds, but is also used in a wider sense

Xerophyte plant that typically grows in dry environments, see also *mesophyte* and *hygrophyte*

Yield coefficient a proportionality constant in the Lockhart equation that refers to the plasticity of *cell wall*s

Yield threshold minimum *turgor* pressure for cell expansion

Zeatin a *phytohormone* belonging to the *cytokinins*, the name stems from *Zea mays* (corn), from which it was first isolated

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