BIOCHAR GLOSSARY

abiotic stress
The negative impact on plants, trees, and soil microbiome not associated with living organisms. Abiotic stress originates from naturally occurring, often intangible and inanimate factors such as intense sunlight, temperature, or wind that may cause harm to plants, trees, and soil microbiome. The most common abiotic stress factors include high winds, extreme temperatures, low water and nutrient availability, floods, chemical pollution, and natural disasters such as wildfires.

absorption
The process of one material (absorbate) being retained by another (absorbent); this may be the physical solution of a gas, liquid, or solid in a liquid, attachment of molecules of a gas, vapor, liquid, or dissolved substance to a solid surface by physical forces

acid soil
Soil with a pH value below 7.

adsorption
An increase in the concentration of an adsorbate at an interface of a condensed phase (adsorbent) and a liquid or gaseous layer due to the operation of surface forces.

adsorption performance
The amount of adsorbate adsorbed on the adsorbent's surface at equilibrium or the proportion of removed adsorbate from solution.

alkaline soil
Soil with a pH value higher than 7.

anion exchange capacity
The sum total of exchangeable anions that a material can adsorb. Expressed as centimoles or millimoles of charge per kilogram of adsorbing material (e.g., soil, clay, or biochar).

arbuscular mycorrhizal fungi
Soil-born fungi (Glomeromycota), obligate symbionts of a very wide range of plant species. The symbioses are biotrophic and normally mutualistic, the long-term compatible interactions being

based largely on bidirectional nutrient transfer between the symbionts. The plant provides photosynthetic carbon to the fungus and the fungus supplies nutrients with poor mobility in soil, particularly phosphorus, sulfur and micronutrients. However, there is more to the symbiosis, as it is also known to suppress losses to pathogens, provide drought and salt resistance, may increase soil aggregation and increase resistance to potentially toxic elements. The interactions of biochar with arbuscular mycorrhizal fungi depend on biochar type, application rate, soil type, crop type and are still under investigation.

aromaticity (of biochar)
The concept of spatial and electronic structure of cyclic molecular systems displaying the effects of cyclic electron delocalization which provide for their enhanced thermodynamic stability (relative to acyclic structural analogs) and tendency to retain the structural type in the course of chemical transformations. A quantitative assessment of the degree of aromaticity is given by the value of the resonance energy. It may also be evaluated by the energies of relevant isodesmic and homodesmotic reactions.

available water
The amount of soil water per unit volume available to plants, calculated as the difference between in situ field capacity and the permanent wilting point.

binary adsorption system
A multi-component system with two types of adsorbates.

binding site
A specific region (atom, functional group) on the external surface or pore walls of biochar that is capable of entering into an interaction with an adsorbate

biochar
A solid, multi-functional, porous carbonaceous product of agricultural biomass pyrolysis in the temperature range of 350 to 1000 °C in the absence of or under limited oxygen. The initial feedstock properties and processing conditions (heating rate, final pyrolysis temperature, residence time, pyrolysis equipment type) largely control the yield and physicochemical properties of biochar. The hydrogen-to-organic carbon (H/Corg) and oxygen-to-organic carbon (O/Corg) ratios of the as-prepared biochar should be below 0.7 and below 0.4, respectively. Biochar is used in a wide range of applications, including but not limited to soil conditioning and remediation, anaerobic digestion of organic wastes, composting, potable water and wastewater treatment, as an additive to animal feed and in composite building materials.

biochar-based catalyst
An engineered biochar where biochar acts as an eco-friendly and versatile catalyst support for applications in areas such as soil remediation, water filtration, chemical synthesis, biofuel production, and catalytic degradation of pollutants [30].

biochar half-life (t 1/2)
The time required for biochar to decompose to half of its original quantity [31], under environmental (temperature, moisture, microorganisms) and other conditions related to the specific biochar application.

biochar charging
The process of adding macro- and micro-nutrients to biochar before soil application. Commonly, this is achieved by mixing it with urine, compost, and manure from livestock.

biochar-coated seeds
Seeds covered in biochar particles. Using biochar-coated seeds increases the retention of water and nutrients around the seeds and surrounding soil. Coating the seeds prior to planting can dramatically reduce the need for high frequency saturation watering in the period immediately following planting and can also increase plant growth and sustain plant life.

biochar composite
The product of biochar and one or more additives, with the purpose of combining the advantageous properties of each material and consequently achieving better performance in a specific application.

biochar inoculation
The process of adding beneficial aerobic microbes and other microorganisms to the biochar surface and pores.

biochar soil amendment
The application of biochar to a soil with the intention to improve one or more soil properties, functions, or ecosystem services such as carbon sequestration.

biochar persistence
The duration that biochar remains in the environment in its original form, typically measured as half-life or mean residence time. Biochar persistence is a result of both the molecular composition of the biochar material itself as well as the environmental conditions, such as soil climate and composition (texture, mineral, and mineralogy composition), content of plant-derived organic matter, and microbial population composition.

biochar sustainability policy
A framework comprising a set of concepts, commitments and action plans toward optimizing environmental, societal and economic aspects of biochar production and application, as agreed between all interested parties (society, industry, and government) [31]. This policy forms part of the International Biochar Initiative (IBI) Certification Program.

biocoal
The product of biomass torrefaction. Not to be confused with biochar, since biocoal is exclusively used as an energy source. Compared to the raw biomass, biocoal has the

advantages of improved energy density, more homogeneous composition, increased hydrophobicity and grindability.

biomass
Material produced by the growth of microorganisms, plants, or animals [38].

biotic stress
The negative impact on plants, trees and beneficial microorganism populations in soil, caused by other living organisms, including fungi, bacteria, viruses, parasites, weeds, insects, and other native or cultivated plants.

black carbon
The pyrogenic carbon materials dispersed in the environment from wildfires and fossil fuel combustion. The term should be taken to refer to the entire material, not just the fused ring fraction or the C atom.

boundary layer
The stagnant region (film) around the adsorbent where properties vary from that in the bulk fluid.

Boyd's model
A diffusion-based model for adsorption kinetics analysis that assumes that the key resistance to adsorption resides in the boundary layer surrounding the adsorbent.

buffering capacity (soil)
The ability of solid phase soil materials to resist changes in ion concentration in the aqueous solution phase. Can be expressed as ΔC s/ΔC l where C s represents the concentration of ions on the solid phase in equilibrium with C l, the concentration of ions in the liquid solution phase. Includes pH buffering as well as the buffering of other ionic and molecular components. The buffering capacity is affected by the presence and types of clay, organic matter and other colloidal constituents. Some biochars may act as a short-term pH buffer.

bulk density
The dry mass of soil or biochar per unit bulk volume. The bulk volume is determined before the sample (soil, biochar, or soil plus biochar) is dried.

bulk solution transport
The movement of the adsorbate through the bulk liquid to the boundary layer of fixed film of liquid surrounding the adsorbent.

capillary condensation

In porous solids, it is the process of multilayer adsorption as vapor proceeds to the point at which pore spaces are filled with liquid separated from the gas phase by menisci. The concept loses its sense when the dimensions of the pores are so small that the term meniscus ceases to have a physical significance.

carbon abatement
The reduction of the amount of carbon dioxide that results from some action, process or intervention. For example, in a slow pyrolysis-based biochar production system, a carbon abatement equivalent to 0.76 tons of CO_2 per ton of feedstock processed was achieved under a conservative soil half-life of 240 years and 29 % biochar mass yield.

carbon cycle
The sequence of transformations whereby carbon dioxide is fixed in living organisms by photosynthesis or by chemosynthesis, liberated by respiration and by the death and decomposition of the fixing organism, or used by heterotrophic species, and ultimately returned to its original state.

carbon footprint
A quantification of the greenhouse gas (GHG) emissions during the life cycle of the product. It is being increasingly applied for multiple purposes, such as: to communicate the carbon footprint to customers, to facilitate the development and implementation of GHG management strategies across product life cycles, to identify potential opportunities for GHG mitigation along the supply chain, to track performance and progress in reducing GHG emissions over time and to assist the consumer in the selection of products with the least climate change impact.

carbon storage (carbon stock)
The quantity of carbon held within a “pool” at a specific time, meaning a reservoir or system which has the capacity to accumulate or release carbon.

carbon capture
The process of capturing carbon dioxide (CO_2) emissions to reduce the amounts of CO_2 entering the atmosphere and to minimize the associated global warming and ocean acidification effects.

cation exchange capacity
The maximum number of moles of adsorbed positive charge that can be desorbed from unit mass of a material under given conditions of temperature, pressure, solution composition, and material-solution mass ratio. Expressed in millimoles of charge per kilogram ($mmol(+)\ kg^{-1}$) of material.

cellulose
A linear polysaccharide consisting of monomeric units of anhydro-D-glucose units. Cellulose is a major component of lignocellulosic biomass, along with hemi-cellulose and lignin. The pyrolysis of cellulose mainly occurs between 315 and 400 °C.

chemical activation (of biochar)
The treatment of biochar with a chemical activation agent (e.g., potassium hydroxide, phosphoric acid, or zinc chloride), followed by heating at a temperature of 450 to 700 °C in an activation kiln in order to increase its porosity. The activated biochar is then washed with water to remove the residues from the activation agent. The filtrate is passed to a chemical recovery unit for recycling.

chemisorption
Adsorption which results from chemical bond formation (strong interaction) between the adsorbent and the adsorbate in a monolayer on the surface.

circular economy
A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.

clayey soil
Texture group consisting of sandy clay, silty clay, and clay soil textures. Family particle-size class for soils with 35 % or more clay and below 35 % rock fragments in upper subsoil horizons.

climate change mitigation
A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

climate smart agriculture (CSA)
An approach to developing the technical, policy, and investment conditions to achieve sustainable agricultural development for food security under climate change. CSA integrates the three dimensions of sustainable development (economic, social, and environmental) by jointly addressing food security and climate challenges [57]. It is composed of three main pillars:

1. sustainably increasing agricultural productivity and incomes
2. adapting and building resilience to climate change
3. reducing and/or removing greenhouse gases emissions, where possible

competitive adsorption
The solute-solute competition for active adsorption sites on biochar in multi-component systems

complexation
Formation of multi-atom structures with specific metal-ligand interactions which include chelation and coordination. It may be surface (outer) or inner sphere complexation.

contaminant immobilization
The process of using biochar to reduce the mobility of harmful and toxic mobile adsorbates (contaminants) as part of environmental remediation measures.

dark earth soil
See Terra Preta soil.

decolorization (by using biochar)
Color removal via adsorption and/or catalytic degradation by biochar of color-laden wastewaters or effluents principally from dyeing operations and tannery and Kraft bleaching processes.

desertification
Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. It is accompanied by a reduction in the natural potential and fertility of the land and a decrease in surface and ground water resources.

designer biochar
See engineered biochar, functionalized biochar.

desorption
A phenomenon in which a substance in an adsorbed state is released from the bulk or surface of a material. It is the opposite of adsorption.

electrical conductivity (EC)
The capacity of a soil-solution mixture or material to conduct or transmit electrical current. In soil and biochar samples it is related to the functional groups and potential electrolyte substances released in water after stirring for a fixed period of time.

electrostatic interaction
The attractive or repulsive interaction between the electric charges on an adsorbate and those present on biochar.

engineered biochar
Biochar that had its physicochemical and/or textural properties purposely tuned during biomass pyrolysis or through post-production physical and chemical processes. The term used to describe application-specific, outcome-based biochar production and/or modification.

enriched biochar
An engineered biochar embedded with inorganic or organic substances. The aim is to produce biochar with specific physicochemical properties and improved performance for a specific application.

environmental remediation
The removal of pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water. Biochar has been widely used in environmental remediation and has proven to be effective in removing organic and inorganic contaminants through adsorption and other mechanisms.

enthalpy

The energy required to raise biomass from room temperature to the reaction temperature and convert the solid biomass into the reaction products of gas, liquids, and biochar. The average value of the enthalpy for pyrolysis for each kg of the biomass tested is approximately 1.5 MJ when the biomass has typical moisture content of 8–10 %. The values for the woody biomass are higher than those of the herbaceous materials.

film diffusion transport
The transport by diffusion of the adsorbate through the fixed (stagnant) liquid film surrounding the adsorbent to the entrance of the pores of the adsorbent.

field capacity (FC)
The content of water, on a mass or volume basis, remaining in a soil 2 days after having been wetted with water after prolonged rainfall or irrigation, and after free gravitational drainage is negligible. Biochar effects on FC vary with feedstock selection, pyrolysis temperature and soil type.

flammability (of biochar)
A flammable biochar is any biochar that is combustible or may contribute to a fire through friction or brief contact with a source of ignition. The flammability of biochar is measured according to the UN Manual of Tests and Criteria, part III N, 1 Test for readily combustible solids.

food security
A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The application of biochar to degraded soils may help toward this purpose.

functional group
An atom or a group of atoms that has similar chemical properties whenever it occurs in different compounds. It defines the characteristic physical and chemical properties of families of organic compounds.

functionalized biochar
See engineered biochar.

gasification (of biomass)
The thermochemical conversion of solid/liquid organic compounds to a gas/vapor phase and a solid phase by heating the material at high temperatures (above 700 °C), without combustion, with a controlled amount of oxygen and/or steam. The gas phase has a high heating power and can be used for power generation or biofuel production. The solid phase includes the organic unconverted fraction and the inert material present in the treated biomass.

greenhouse gas (GHG) emissions

Gases that trap emanated heat in the atmosphere are called greenhouse gases. These include but are not limited to the following: carbon dioxide, methane, nitrous oxide, and fluorinated gases. The primary sources of greenhouse gas emissions are transportation, electricity production, heavy industry, commercial and residential activity, and agriculture.

hydrochar
The solid product of hydrothermal carbonization (HTC) or liquefaction (sometimes referred to as HTC material), and is distinct from biochar due to its production process and properties. It typically has higher H/C ratios and lower aromaticity than biochar as well as little or no fused aromatic ring structures.

hydrothermal carbonization (HTC)
The treatment of biomass or any biodegradable waste with water at a temperature in the range of 100–374 °C in a closed reactor at a pressure that maintains water in the liquid state (as defined by the volume of the reactor and the thermodynamic properties of water in this temperature range). The result is a solid product with increased carbon content (hydrochar) and the residual water, referred to as HTC wastewater.

International Biochar Initiative (IBI) Certification Program
A voluntary scheme administered by the International Biochar Initiative to provide certification of biochar products. The purpose of the program is to provide biochar manufacturers the opportunity to demonstrate that their biochar (s) meet the minimum criteria established in the latest IBI Biochar Standards. Currently, the IBI standards apply to biochar produced in North America.

intra-particle diffusion
The transport of the adsorbate through the pores by a combination of molecular diffusion through the pore liquid and/or by diffusion along the surface of the adsorbent.

ion exchange
The exchange of cations and anions on biochar surface with dissolved species in the liquid phase.

isoelectric point (IEP)
The pH value at which the net electric charge of an elementary entity is zero.

labile carbon
Soil organic matter in transition from fresh residues to CO2 or inert C. Much of it consists of recently incorporated plant, faunal, and microbial debris, with a turnover time of less than a decade.

lignin
An organic polymer, composed of phenolic propylbenzene skeletal units, linked at various sites and apparently randomly. A major component of lignocellulosic biomass, along with cellulose

and hemi-cellulose. During pyrolysis, lignin slowly decomposes over the temperature range of 150–900 °C.

liming effect
The effect that a material delivers to acidic soils through increasing soil pH and reducing the solubility of aluminum and manganese, and through amending soil physical, physicochemical, chemical, and biological properties.

liquefaction
A relatively low-temperature (300–400 °C), high-pressure (40–200 bar) process that produces bio-oil from a relatively wet biomass in the presence of a catalyst and hydrogen.

loamy soil
(i) Texture group consisting of coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam soil textures. (ii) Family particle-size class for soils with textures finer than very fine sandy loam but below 35 % clay and below 35 % rock fragments in upper subsoil horizons.

magnetic biochar
An engineered biochar that has undergone modification with magnetic precursors for the primary role of facilitating separation of powdered biochar grades from aqueous solution when exposed to a magnetic field.

macropores
In material and engineering sciences, macropores are the pores with a diameter exceeding 50 nm. In soil science, a class of pores with an equivalent diameter higher than 75 μm. Very coarse macropores drain water very quickly and are responsible for preferential flows. Macropores are good for soil aeration.

mean residence time (MRT)
The average time for which biochar is present in soil and is determined as the inverse of the decay rate.

mesopores
In material and engineering sciences, mesopores are defined as having a diameter in the range of 2–50 nm. In soil science, a class of pores with the equivalent diameter between 30 and 75 μm. These pores contribute to capillary water flow and solute movement by advection and diffusion. The mesopore size is ideal to hold water that is easily available to plants.

micropore filling
The process in which molecules are adsorbed in the adsorption space within micropores.

micropores
In material and engineering science, micropores have a diameter of less than 2 nm. In soil science, a class of pores with the equivalent diameter between the range of 5–30 μm. Pores

smaller than 5 μm when not classified are also added to the micropores. The water within these pores drains very slowly and is not available to all plants. To enhance available water, biochar should ideally have pores larger than micropores and smaller than the larger macropores than drain water too quickly.

monolayer adsorption
Adsorption in which all adsorbate molecules or ions are in contact with the surface layer of the adsorbent thus leading to a single layer of adsorbed species. Usually characteristic of chemisorption.

monolayer adsorption capacity
The quantity of adsorbate molecules or ions needed to occupy all adsorption sites as determined by the structure of the adsorbent and by the chemical nature of the adsorbate for chemisorption.

multi-component systems
Adsorption systems with more than one type of adsorbate.

multilayer adsorption
Adsorption such that the adsorption space accommodates more than one layer of molecules, and not all adsorbed molecules are in contact with the surface layer of the adsorbent. Normally typical of physisorption.

nano biochar
Biochar having particle sizes below 100 nm, achieved through mechanical or thermal means.

nutrient availability (in soil)
The portion of any element or compound in the soil in chemical forms that can be readily taken up and assimilated by plants.

nutrient recycling
The reuse of collected or recovered nutrients in agriculture. It involves nutrient collection through the gathering of waste material including preliminary sorting and storage prior to a subsequent direct use or processing, and nutrient recovery through which a nutrient is extracted, purified, or concentrated from a substrate.

physical activation (of biochar)
The process of increasing the porosity of a carbonaceous material through the use of an oxidizing agent, such as steam, ozone, carbon dioxide, or air at temperatures usually above 700 °C. These oxidizing agents penetrate into the internal structure of char and gasify the carbon atoms, which results in opening and widening of inaccessible pores.

physisorption

Adsorption in which the forces involved are intermolecular forces (van der Waals forces) of the same kind as those responsible for the imperfection of real gases and the condensation vapors, and which do not involve a significant change in the electronic orbital patterns of the species involved.

point of zero net charge (PZNC)
The condition of the solution for which the surface charge density of the adsorbent equals zero. It measures net surface charge (both internal and external).

pore blocking
The obstruction to entry or exit of adsorbates in pores or capillaries with pore width comparable to the molecular size of the adsorbate. Pore blocking may also be a result of capillary condensation where the liquid-like phase in the pore of the biochar prevents entry or exit of adsorbates.

pore size
The distance between two opposite walls of the pore (diameter of cylindrical pores, width of slit-shaped pores). Pore sizes are classified as micropores, mesopores, and macropores.

pore size distribution
The distribution of pore volume with respect to pore size; alternatively, it may be defined by the related distribution of pore area with respect to pore size.

porosity
The total volume of pores and voids divided by the volume occupied by the solid.

precipitation
The formation of insoluble solids on the surface of biochar during sorption processes and as a result of the reaction between the adsorbate metallic ions with the mineral phases entrained in the biochar. Precipitation (under ambient conditions or elevated temperature and pressure) is also a common method through which various types of metal oxide nanoparticles are deposited on the biochar surface.

priming effect (of biochar)
An increase or decrease in mineralization of one source of organic matter (e.g., native soil organic matter) due to the addition of a new organic matter source (e.g., biochar).

pyrochar
See biochar.

pyrogenic carbon

“Pyrogenic C” (abbreviated to PyC after first use) is synonymous with black C. It should be used preferentially to “black C”. PyC (or black C) refers to the (non-inorganic) C atoms that have undergone pyrogenic or thermal transformation, and by this definition only include C present in fused rings, including C on surfaces of fused aromatic C that may also bind to other atoms such as O and N, non-hydrogenated C, and hydrogenated C.

pyrogenic carbon capture and storage (pyccs)
A promising carbon sequestration technology that can mitigate climate change while improving soil fertility. The technological opportunities of PyCCS are represented by three tracks accounting for the sequestration of different pyrolysis products: biochar (as soil amendment), bio-oil (pumped into geological storages), and permanent-pyrogas (capture and storage of CO2 from gas combustion).

pyrogenic organic matter
An umbrella term for all materials that are produced by thermochemical conversion and contain some organic C, such as charcoal, biochar, char, black carbon, soot, activated carbon, and may contain some or no pyrogenic carbon (PyC). The term refers to the material and not the C atom.

pyrolysis (of biomass)
Thermolysis (of biomass), usually associated with exposure to a high temperature in the absence, or limited concentration of oxygen.

recalcitrance index
A temperature-programmed oxidation index to specifically evaluate the thermal oxidative stability of biochar. The recalcitrance index corresponds to relative stability as compared to graphite.

regenerant
The substance or solution used to restore the adsorption capacity of spent biochar.

regeneration
The process used to recover the adsorption capacity of the spent biochar without repeating a chemical or physical activation step. It may include chemicals to oxidize the adsorbed material, steam to drive off the adsorbed material, solvents and biological conversion processes.

regeneration cycles
The number of repeated adsorption-desorption cycles that biochar can be subjected to after which further usage as adsorbent will be economically unattractive as a result of decreased adsorption capacity.

sandy soil
(i) Texture group consisting of sand and loamy sand textures. (ii) Family particle-size class for soils with sand or loamy sand textures and below 35 % rock fragments in upper subsoil horizons.

slash-and-char agriculture
A sustainable agricultural practice where vegetation is cleared and then charred on site to biochar rather than burnt to ash.

smart biochar
See engineered biochar, functionalized biochar.

soil aeration
The proportion of air-filled pores in the soil. The process by which air in the soil is replaced by air from the atmosphere. Depends largely on the structure of the medium, the volume and continuity of pores. Addition of biochar may increase soil aeration in certain soil types, mainly those with high clay content.

soil albedo
The fraction of the incident radiation that is reflected from the soil surface. Its value ranges from 0 to 1, where 0 represents a blackbody (theoretical medium) absorbing 100 % of the incident radiation. Biochar is close to a blackbody and will lower the albedo of bare soils to which it is applied as a power function with increasing biochar application rate, depending on soil moisture content and biochar application method.

soil bulk density
The mass of dry soil per unit of bulk volume, including the air space. The bulk density of most soils is reduced after biochar addition.

soil carbon sequestration
Land management strategy that increases the soil organic carbon content, resulting in a net removal of CO2 from the atmosphere.
See carbon storage (carbon stock), climate change mitigation, carbon abatement.

soil erosion
The movement and transport of soil by various agents, particularly water, wind, and mass movement. Factors such as rainfall intensity, rainfall volume, slope angle, soil properties, land use, and land management determine soil erosion rates. Soil erosion is reversible if certain soil protection and rehabilitation measures are taken. Biochar addition to weathered soils can help reduce soil losses, by improving their physical properties (such as aggregate stability) and increase erosion resistance.

soil hydraulic conductivity
An expression of the readiness with which a liquid, such as water, flows through soil, in response to a given potential gradient. Represents the ability of a porous medium to conduct water. The effect of biochar on soil hydraulic properties depends on the feedstock and amount of biochar added and soil type including soil texture, aggregation, mineralogy. Contrasting results are found in the biochar studies.

soil organic matter (SOM)

The sum total of all organic carbon-containing substances in soils. Chemically and physically, SOM consists of a mixture of plant and animal residues in various stages of decomposition and recombination, substances synthesized microbiologically and/or chemically from the breakdown products, and the bodies of live and dead microorganisms and small animals and their decomposing remains.

soil pH
The pH of a solution in equilibrium with soil.

soil separates
The specific ranges of soil particle sizes. The smallest particles are clay particles and are classified as having diameters of less than 0.002 mm. Clay particles are plate-shaped instead of spherical, allowing for an increased specific surface area. The next smallest particles are silt particles and have diameters between 0.002 mm and 0.05 mm (in the United States Department of Agriculture (USDA) soil taxonomy). The largest particles are sand particles and are larger than 0.05 mm in diameter. Furthermore, large sand particles can be described as coarse, intermediate as medium, and the smaller as fine. Other countries have their own particle size classifications.
The relative proportions of the various soil separates in a soil as described by the 12 classes of soil texture The limits of the various classes are as follows:
Clay: Soil material that contains 40 % or more clay, below 45 % sand, and below 40 % silt.
Clay loam: Soil material that contains 27 to 40 % clay and 20 to 45 % sand.
Loam: Soil material that contains 7 to 27 % clay, 28 to 50 % silt, and below 52 % sand.
Loamy sand: Soil material that contains between 70 and 91 % sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or more; and the percentage of silt plus twice the percentage of clay below 30 %.
Sand: Soil material that contains 85 % or more of sand; percentage of silt, plus 1.5 times the percentage of clay, shall not exceed 15.
Sandy clay: Soil material that contains 35 % or more clay and 45 % or more sand.
Sandy clay loam: Soil material that contains 20 to 35 % clay, 45 % sand.
Sandy loam: Soil material that contains 7 to 20 % clay, above 52 % sand, and the percentage of silt plus twice the percentage of clay is 30 or more; or below 7 % clay, below 50 % silt, and above 43 % sand.
Silt: Soil material that contains 80 % or more silt and below 12 % clay.
Silty clay: Soil material that contains 40 % or more clay and 40 % or more silt.
Silty clay loam: Soil material that contains 27 to 40 % clay and below 20 % sand.
Silt loam: Soil material that contains 50 % or more silt and 12 to 27 % clay (or) 50 to 80 % silt and below 12 % clay.

spent biochar

The term given to biochar with an exhausted adsorption capacity and which requires regenerative or reactivation processes to recover its adsorptive capacity. This is the case where the adsorbate's rate of adsorption onto and desorption off the adsorbent are in equilibrium.

Terra Preta soil
Terra Preta (de Índio) is the local Portuguese name for a soil anthropogenically enriched by ancient indigenous cultures with nutrients and carbon that occurs, mainly, in some parts of the Amazon Basin, and literally means "Indian Black Earth." It commonly contains human artifacts (ceramics), moreover it is enriched with P, Ca, Sr, Ba, Mn, and pyrogenic carbon. It is a source of inspiration and a model for some biochar research topics.

torrefaction (of biomass)
Thermochemical processing of biomass at atmospheric pressure, absence of oxygen and at temperatures typically between 200 and 320 °C. Torrefaction changes biomass properties to provide a better fuel quality for combustion and gasification applications. The final product is the remaining solid, dry, blackened material that is referred to as torrefied biomass or biocoal. Depending on the feedstock and required product quality excess heat can be generated for drying purposes or electricity production.

water holding capacity
The ability of a soil to contain and to retain water. Dependent upon the factors, which determine hydraulic conductivity and permeability, e.g., texture, organic matter, porosity, and interconnectedness of pores.

wilting point
The mass of water per unit weight or per unit soil bulk volume in the soil, expressed in percent, is held so tightly by the soil matrix that roots cannot absorb this water and a plant will wilt.
See field capacity, water holding capacity.

Yoshida H-bonding
Occurs between O and/or N-containing functional groups on the biochar surface.