

## Lesson Sheet 3 — Organic Matter and Soil

Terminology. organic, organic matter, humus, soil, soil amendment (soil conditioner, soil additive), compost, composting.

Definition. organic, **organic matter**: once-living organisms, which includes dead plants, dead organisms (worms, insects, birds, animals, etc.), decaying or decayed (humus).

\* *The other meaning of 'organic,' refers to foods grown with no chemical fertilizers (including no sewage sludge as fertilizer (biosolids) since they may contain pharmaceuticals, heavy metals, and other hazardous substances), no synthetic pesticides, no irradiation, no solvents, no chemical food additives, and no genetically modified seeds. Commercial operations who want to market their products as organic, can get their products to be Certified Organic; there are different programs/organizations that confer organic certification, including the USDA (USDA Organic, National Organic Program), and CCOF (California Certified Organic Farmers, ccof.org). Another way 'organic' is labeled is where the produce was grown in 'traditional ways' with no agricultural chemicals (fruit and vegetable sold with stickers with a 5-digit code starting with the number '9'). In the case where the organic certification does not apply (usually only products sold directly to consumers are Certified Organic), there's a designation called "OMRI Listed" (Organic Materials Review Institute, [omri.org](http://omri.org)) which is for on-farm use products for organic operations—where the farm can use OMRI Listed products and maintain their organic certification.*

**Humus** — the organic part of soil, particularly formed by soil microbes decomposing leaves and plant materials.

**Compost** — decayed organic matter — where it does not break down further (aged, mature compost); stable biological activity.

**Composting** — the process of decaying organic matter — decomposition at the molecular level by microorganisms; high biological activity. There are various methods of composting, including the following:

psychrophilic composting (cold composting, slow composting), mesophilic composting (low temperature composting), thermophilic composting (high temperature composting, hot composting), hyperthermophilic composting (very high temperature composting), vermiculture (vermi-composting, worm composting). See <http://www.recyclefoodwaste.org/files/compostingtypesbiol.pdf>

**Soil** — there are 4 main parts to soil (percentages below are for generally good soil):

organic part 1% – 5%

inorganic part ~45%

water ~25%

air ~25%

inorganic (rock/mineral particles) type by particle size		
clay	silt	sand
< 0.004 mm (< 0.00016 inch)	0.002 ~ 0.060 mm (0.00008 ~ 0.00236 inch)	> 0.060 mm (> 0.00236 inch)

Loam, loamy — soil with clay and sand (or clay, sand, and silt of roughly the same proportions) and humus.

Peat, peaty — soil with high organic matter content (histosol—see soil taxonomy), high water retention, carbon sink; see peat moss over-harvesting issue.

Chalky — soil that's largely calcium carbonate (chalk, limestone), i.e., lime-rich soil; neutral to alkaline (pH 7.1 – 8.0).

Potting soil — for growing plants in pots and planters/containers; mostly organic matter mix (little soil since adds weight): compost, peat, sand, perlite, etc. perlite (hydrated obsidian, non-crystallized volcanic glass — tiny, white rock appearance in some potting soils) used as a soil amendment, improves permeability (water and air flow), prevents compaction; a non-renewable source—a couple of substitutes: diatomaceous earth, vermiculite.

Soil texture: proportions of clay, silt, and sand; soil structure (attributes): porosity, aeration, permeability, water retention and movement, thermal/heat characteristics, plant rooting (rhizosphere and its mycorrhiza), nutrient level and flow (bioavailability; mycelial network), and compaction prevention.

Soil issues: salinity (saline/sodic soil; sodium), acidic (low pH), alkaline (high pH), chalky (too alkaline case), saturation/drainage, desertification, compaction, contamination, brownfield, soil erosion, soil denudation (stripping off/removing surface soil/soil covering, leading to erosion, landslides), low organic content.

Soil treatments — to either remediate/decontaminate and/or improve soil quality (only a few of many methods/terms are listed here): soil remediation (soil cleaning, soil washing) by various methods, including bioremediation (using microbes), mycoremediation (using fungi/mushrooms), phytoremediation (using plants), using soil amendments (also, soil conditioners, soil additives).

**Soil amendments** include compost, lime, chalk, perlite, zeolite, peat, peat moss, as well as, bokashi. Soil amendments are an important way to maintain or improve the organic matter content in soil.

**Organic matter in soil**, 3 overall factors:

**Microbial life** — from beneficial bacteria to fungi; cycle of life and nutrient flow and bioavailability; attracts other organisms; biodiversity.

**Nutrients** — from organic and inorganic sources, including micronutrients and macronutrients (essential elements for plant growth).

**Organic matter content** — soil structure, soil quality, carbon sink/carbon sequestration (soil organic carbon).

Organic matter in soil (soil organic matter) is essential. It's the source of most of the nutrients (minerals can also come from the inorganic part of soil). It's the medium where microbial life mostly propagates, and from which most other soil life get their food source, including the microbes (worms and insects consume microbes). It improves soil structure and quality, and plays an important part in the carbon cycle.

About **NPK** (Nitrogen (N), Phosphorus (P), Potassium (K)) **fertilizer** numbers (displayed on fertilizer product packages as, e.g., 10-24-16 or 2.5-1-1 as % of the total content; 10-24-16 on a 10 lb fertilizer package means 10% or 1 lb N, 24% or 2.4 lbs P, 16% or 1.6 lb K — In the U.S. and some other countries, a material is considered a fertilizer if it meets certain NPK qualifications (a minimum guaranteed amounts of NPK); otherwise, it is not strictly a fertilizer; many soil amendments, including bokashi, compost, and manure, would not be called fertilizers since their NPK is either unknown, low in value, and/or their NPK values are generally inconsistent from batch to batch, regardless of whether or not they contain N, P, and/or K. However, NPK is only a small part of what plants need; plants need an entire ecosystem of soil life (bacteria, fungi, worms, soil insects), including other plant life, insects, birds, and animals: pollinators, decomposers, detritivores, scavengers, and their excreta; and environmental conditions (temperature, light, air quality, water sources). Chemical fertilizers (synthetic fertilizers) provide NPK that can be quickly taken up by plants, but does **not** provide organic matter. Organic fertilizers, on the other hand, can provide organic matter and provide NPK and other nutrients that are gradually available to the plants over a period of time.