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SOIL ORGANIC MATTER

Soil organic matter (SOM) is defined as the summation of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and well-decomposed substances. Though living organisms aren't considered within this definition, their presence is critical to the formation of SOM. Plant roots and fauna (e.g., rodents, earthworms and mites) all contribute to the movement and breakdown of organic material in the soil.

SOM exerts numerous positive effects on soil physical and chemical properties, as well as the soil's capacity to provide regulatory ecosystem services.

Soil organic matter cycling consists of four main processes carried out by soil microorganisms (Figure 1):

1) decomposition of organic residues;
2) nutrient mineralization;
3) transfer of organic carbon and nutrients from one SOM pool to another;
4) continual release of carbon dioxide (CO_2) through microbial respiration and chemical oxidation.

Both active and slow SOM are biologically active, meaning they are continually being decomposed by microorganisms, thereby releasing many organically-bound nutrients, such as N, P, and other essential nutrients, back to the soil solution. Active SOM is primarily composed of fresh plant and animal residues and will decompose fairly rapidly. Slow SOM, consisting primarily of detritus (cells and tissues of decomposed material), is partially resistant to microbial decomposition and will remain in the soil longer than active SOM. In contrast to active and slow SOM, passive SOM, or humus, is not biologically active and is the pool responsible for many of the soil chemical and physical properties associated with SOM and soil quality.

Humus breaks down very slowly and may exist in soil for hundreds or even thousands of years. Due to its chemical make-up and reactivity, humus is a large contributor to soils ability to retain nutrients on exchange sites. Physically, dissolved organic chemicals act to 'glue' soil particles together, enhancing aggregation and increasing overall soil aeration, water infiltration and retention, and resistance to erosion and crusting. The dark consistency of humus causes soils high in SOM to be dark brown or black in color, increasing the amount of solar radiation absorbed by the soil and thus, soil temperature.

Soils high in clay and silt are generally higher in SOM content than sandy soils. This is attributed to restricted aeration in finer-textured soils, reducing the rate of organic matter oxidation, and the binding of humus to clay particles, further protecting it from decomposition. Additionally, plant growth is usually greater in fine-textured soils, resulting in a larger return of residues to the soil.

Poorly drained soils typically accumulate higher levels of SOM than well-drained soils due to poor aeration causing a decline in soil oxygen concentrations. Many soil microorganisms involved in decomposition are aerobic (oxygen requiring) and will not function well under oxygen-limiting conditions.

Climate impacts decomposition and accumulation by affecting growth conditions for soil microorganisms. High temperature and precipitation results in increased decomposition rates and a rapid release of nutrients to the soil (Figure 2). Conversely, decreases in temperature and precipitation cause decomposition rates to slow. This results in greater SOM accumulation and a less rapid release of nutrients.

Cropping practices, such as tillage and fertilization, have had long-term effects on SOM levels over the last 75 years. Cultivated land generally contains lower levels of SOM than do comparable lands under natural vegetation. Unlike natural conditions where the majority of plant material is returned to the soil, only plant material remaining after harvest makes it back to the soil in cultivated areas. Furthermore, tillage aerates the soil and breaks up organic residues, thus stimulating microbial activity and increasing SOM decomposition. Residue burning lowers SOM levels by reducing the amount of residue available for SOM formation. Fertilizer applications can result in an increase in SOM levels due to greater yields creating a larger return of crop residues to the soil.

Soil organic matter was determined by determining the total carbon content on the wet road method Walkley - Black.

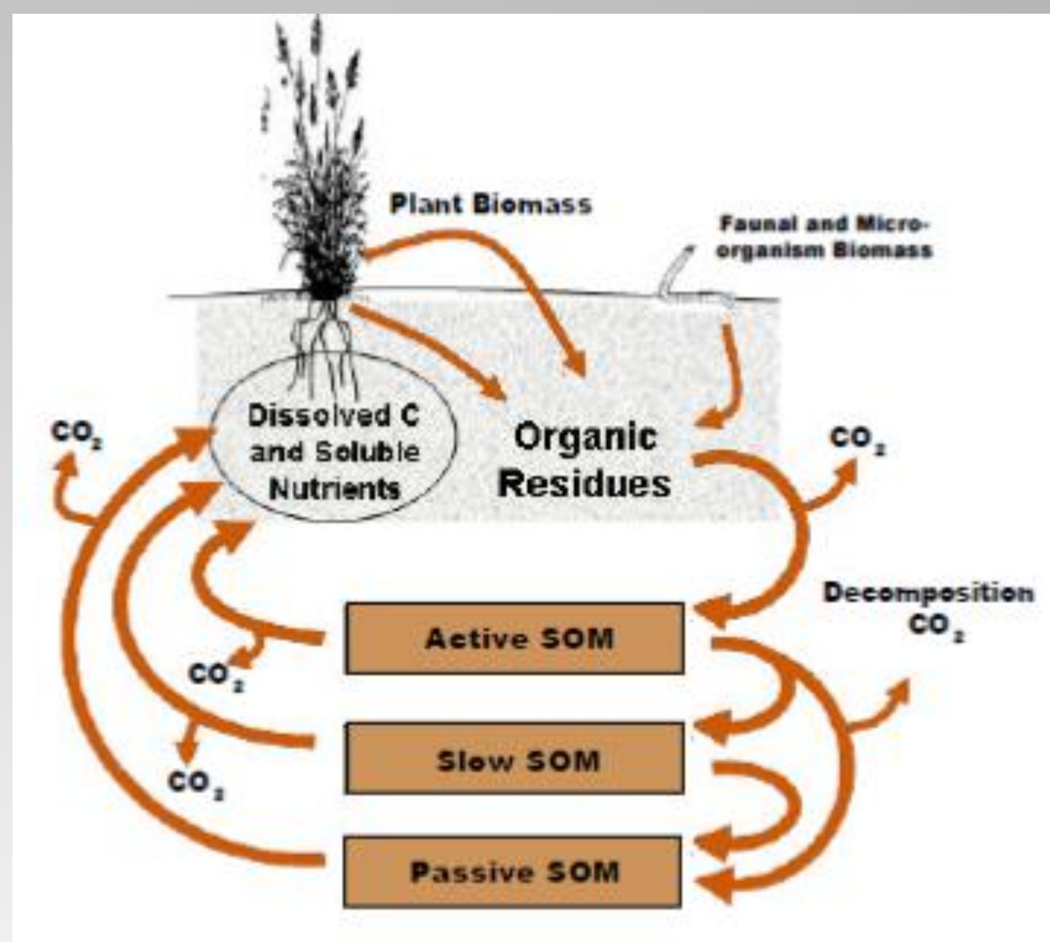

Figure 1 Organic matter cycle

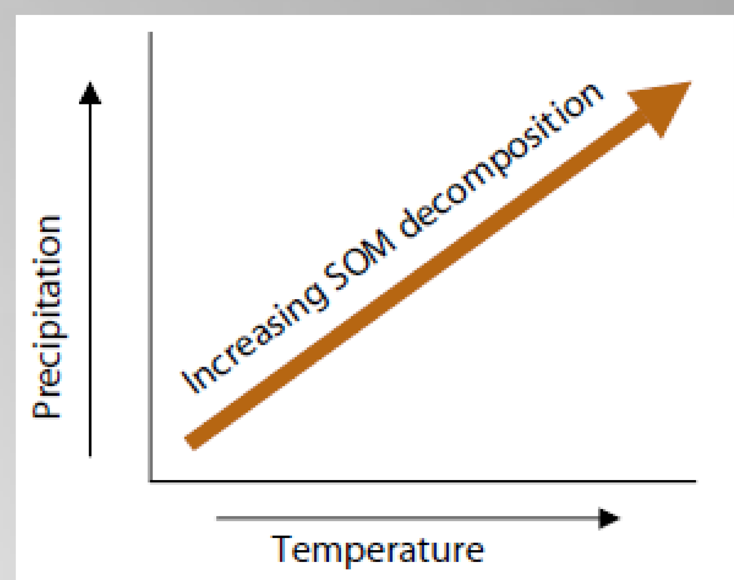

Figure 2 Effects of temperature and precipitation on SOM decomposition

Determining total C in soil by wet combustion in 1916. Walkley and Black modified procedure a rapid method for approximating soil organic matter content by wet combustion. This early wet combustion methods utilized $K_2Cr_2O_7$ as an oxidizing agent. The feat of dilution generated by the addition of concentrated H_2SO_4 to the mixture of soil and aqueous $K_2Cr_2O_7$ with Fe $(NH_4)_2(SO_4)_2$.

SOM is typically estimated to contain 58 % C.

$$\textit{Humus (\%)} = C_{org} * 1.724$$

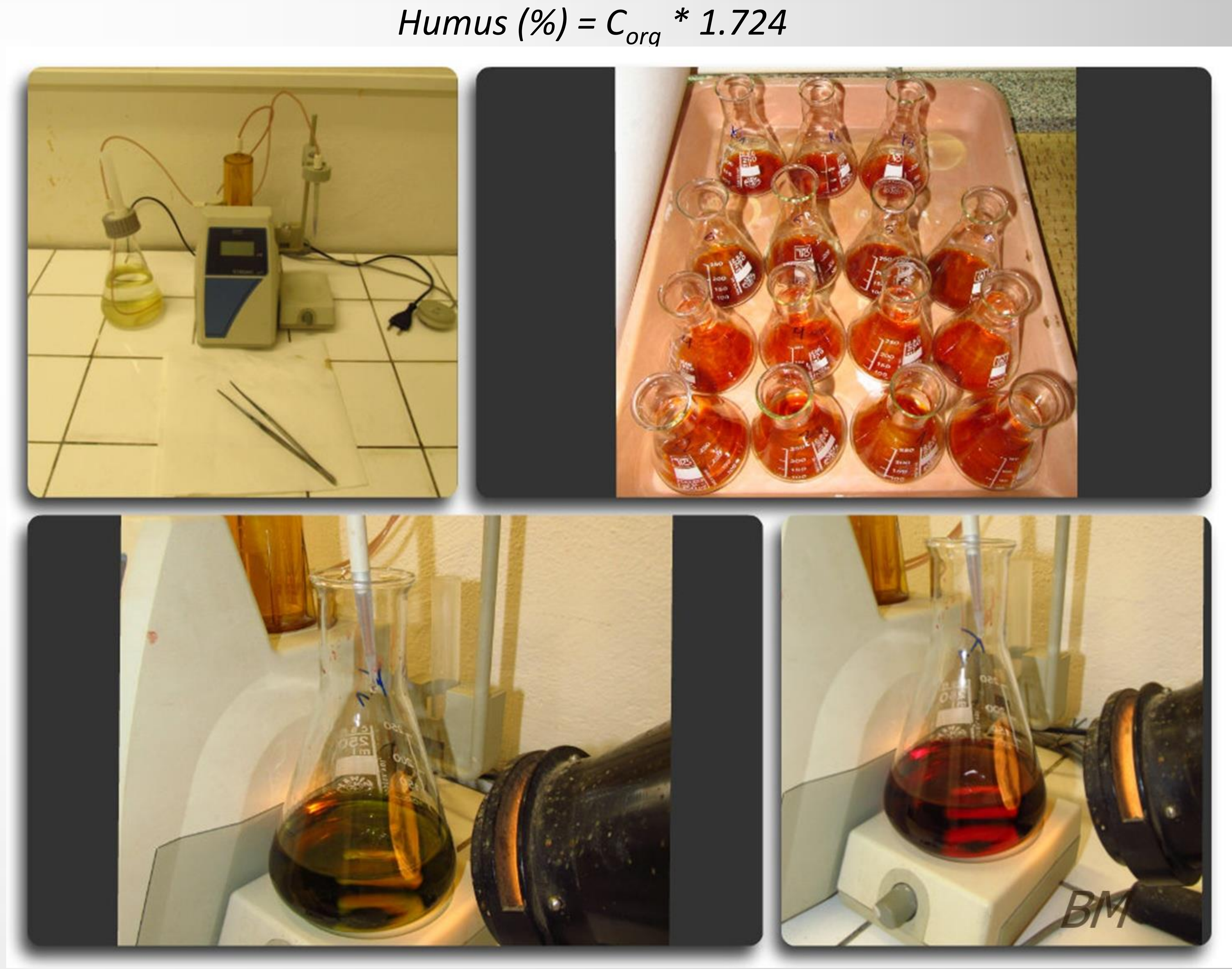

Table 1 Humus content in the topsoil our soil :

Humus (%)	Label content
< 1.0	Very low
1.0 – 2.0	Low
2.0 – 3.0	Medium
3.0 – 5.0	High
> 5.0	Very high

Label soil	Humus (%)
Chernozem	2.2 – 4.5
Luvisol	1.7 -1.9
Albic Luvisol	1.5 – 3.6
Fluvisol	3.3. – 4.5
Gleysol	0.9 – 2.9
Cambisol	1.7 – 4.3

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