Soil Organic Matter (SOM)

Important component in soil fertility
The higher the SOM – soil more fertile
Advantages of OM

• Supply nutrients (especially N, P, S)
• Increase CEC
• Improve physical properties (“soil conditioning”)
  -- water infiltration
  -- water holding capacity
  -- easily tilt
• Act as surface mulching (control erosion, reduce water loss)
Chemical characteristics of SOM

- Carbohydrates: sugar, starch, cellulose and hemicellulose. Almost 75% wt
- Amino acid and protein
- Fats, waxes
- Acid nucleic
- Lignin and phenol compounds
Soil Organic Matter

- The SOM content of agricultural topsoil is usually in the range of 1 to 6%. This amount is the result of all additions and losses of SOM that have occurred over the years.
SOM added to soil by addition of plant residues

- Up to 15% of organic matter is fresh residue
- Comprised mainly of litter fall
- Much can be recognized as plant residue
Decomposition of SOM

- Occurs with the help of macro and microorganisms (fungi & bacteria) on plant residue and animals
- Rate of decomposition depends on SOM composition
Rate of decomposition

- **SOM Composition**                          **Rate**
  - Starch and sugars                           fast
  - Protein
  - Hemicelluloses
  - Cellulose
  - Lignin, Fat                                 slow

Eg Paddy straw decays longer compared to legumes-due to higher lignin content
• **Products of decay**:

1. **Simple materials**:
   - **C**: $CO_2$
   - **N**: $NH^+ / NH_3, NO_3^-, NO_2^-$
   - **S**: $SO_3^-, SO_4^{2-}$
   - **P**

2. **Humus** - dark colour/black - colloid size

3. **Energy for living microbes** - heterotroph
Factors affecting decay of SOM

1) Types of plant: age and species

2) Plant nutrient content
   - decay process is accelerated by higher N source.

3) Soil nutrient content - food for microbes to continue their activity

4) Aeration - Oxygen supply
5) Moisture
6) Temperature
7) Type and no. of organism. e.g fungi/bacteria/worm/small animal
8) Type of soil
C/N ratio.

Soil 10:1
Peanut 20:1
Paddy straw 70:1
Saw dust 200:1

- Organic matter high in N content, low C/N ratio, will decay fast
- SOM with low N has C/N, will decay slowly
How is N removed from soil?

1. Erosion: N - organic in the litter and humus
2. Harvesting: N - organic in the harvest
3. Leaching: $\text{NO}_3^-$ and $\text{NH}_4^+$
4. Denitrification: $\text{NO}_3^- \rightarrow \text{N}_2$
5. Burning of soil residue N - organic - > gas
Management of soil N

1) Addition of organic matter: plant and animal residues, fertilizer and green fertilizer

2) Addition of N- fertilizer

3) Planting of legumes to increase N-fixation

4) Use of slow release fertilizer e.g sulfur - coated urea
Function of SOM

1. Influence
   a) soil aggregates and fertility
   b) permeability, aeration
   c) erodibility

2. Increase WHC and CEC

3. Nutrient source: N, S, P and micro nutrients

4. Source of energy for living soil organisms especially heterotroph
Management of SOM

- Addition of plant residues e.g. corn stem, legumes, paddy straw, EFB and cow dung or chicken dung
- However, addition of organic residue e.g. sewage sludge and POME limits its use due to increase in heavy metal content, Cd, Ar, and Pb.
- Control erosion on the top soil with addition of organic matter
Mulching with EFB
• Control erosion on the top soil with addition of organic matter
Soil Organic Matter = SOM

- **SOM** is **labile** - it can decline rapidly if the soil environment changes and is **renewable** - it can be replenished by inputs of organic material to the soil.
- Adequate levels of SOM can be maintained with proper fertilization, crop rotations, and tillage practices if crop residues are returned to the soil.

*Labile = Constantly or readily undergoing chemical, physical, or biological change or breakdown; unstable.*
How is SOM Measured?

SOM is usually measured in the laboratory as organic carbon,

Soil organic matter is estimated to contain 58% organic carbon (varies from 40 to 58%) with the rest of the SOM comprising of other elements (eg, 5% N, 0.5% P and 0.5% S).

A conversion to SOM from a given organic carbon analysis requires that the organic carbon content be multiplied by a factor of 1.72 (1.00/0.58).

Thus, 2% SOM is about 1.2% organic carbon.

Testing for Soil Organic Carbon

UF/IFAS Extension Soil Testing Laboratory
Stable Organic Matter - Humus

• Thus, soil organic compounds become stabilized and resistant to further changes by microorganisms.

• Stabilized organic matter acts like a sponge and can absorb six times its weight in water.
HUMUS

- Newly-formed humus -
  a) combination of resistant materials from the original plant tissue,
  b) compounds synthesized as part of the microorganisms' tissue which remain as the organisms die.
  (Fluvic and Humic Acid)

- humus is resistant to further microbial attack- N and P are protected from ready solubility.
Function of Humus

- holds water and nutrients;
- it sticks together & helps establish and maintain a strong crumb structure & thus reduce soil erosion
- it provides some nutrients (N & P) as it is slowly decayed by microbial activity,
- Buffers effects of pesticides
- humus decomposes at the rate of 2.5% per year
- Creates good soil “Tilth”
SOM Maintains soil “Tilth”

- aiding infiltration of air and water
- promoting water retention
- reducing erosion