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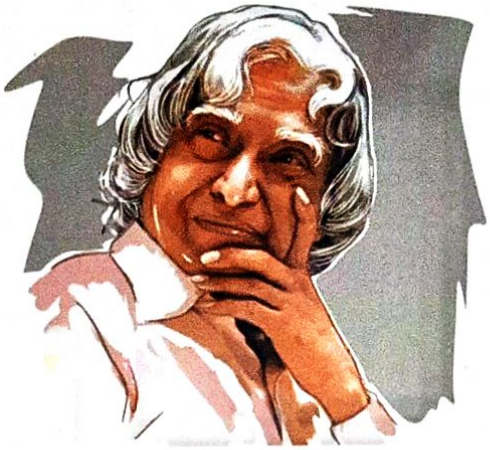

Project Work

A.P.J.Abdul Kalam - Group

Session - 2021-22

BSc III Bio

Topic - Cropland (Village) soil analysis of three different villages

30/03/2022

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Submition Date - 30/03/2022

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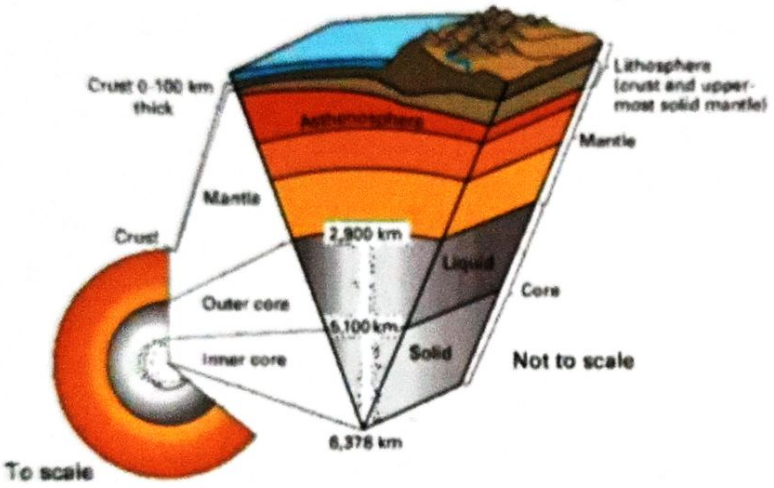
SOIL

- latin word **'solum'** means floor or ground.
- **Pedology'** is study of soil which includes origin of soil, its classification and its description.
- **'Edaphology'** is the study of various properties of soil in relation to growth, nutrition and yield of crops.
- *"Soil is a natural body developed by natural forces acting on natural materials. It is usually differentiated into horizons of minerals and organic constituents of variable depths which differ from the parent materials in morphology, physical constitutions, chemical properties, composition and biological characteristics"- Joffe and Marbut.*
- Soil :- Region on the earth surface where geology and biology meet each other.

  Or

  Upper most layer of earth crust which is biologically active.



What is a soil profile?

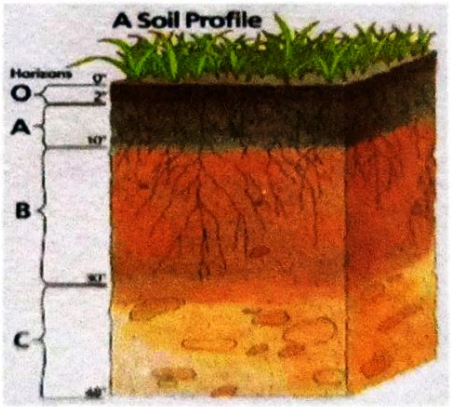
A soil profile consists of several **soil horizons**.

O horizon
- humus on the ground surface.

A horizon
- Top soil.
- Rich in organic matter. Typically dark color.
- Also called zone of **leaching**.

B horizon
- Subsoil.
- Also called zone of accumulation.
- May contain soluble minerals such as calcite in arid climates (caliche).

C horizon
- Weathered bedrock (rotten rock).
- Bedrock lies below the soil profile.

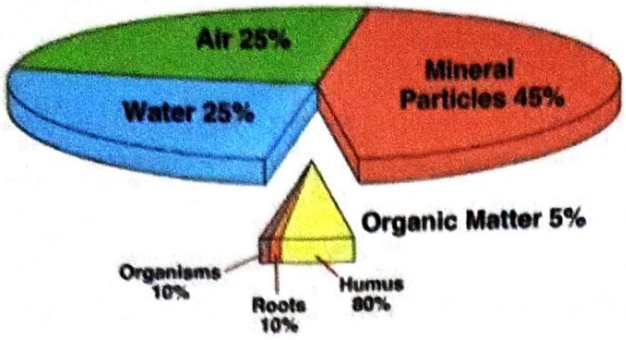


- **Soil Formation:**
  1. Weathering or disintegration of bed rock forming regolith.
  2. Decomposition of plant and animal residue, resulting addition of Organic matter

3. Reorganization of these components by soil material of varying depth.

COMPOSITION

- In general, **soil** contains 45% **inorganic** matter, 5% organic matter, 25% water, and 25% air.



1. **Mineral Components:**derived from the parental rocks or regolith by weathering, found in the form of particles of different sizes like sand, silt and clay. Important elements eg. Si, Fe, Al, N, P, K, Ca, Mg, C, H & O etc.

2. **Organic Matter or Humus:**derived by decomposition of dead remains of plants and animals or through metabolic activities of living organisms are present in the soil.

HUMUS: product of microbial decomposition,dark coloured,dynamic,jelly-like amorphous substance composed of residual organic matters not readily decomposed by soil microorganisms. The process of humus formation is called humification.

Major elements: Carbon, hydrogen, oxygen, sulphur and nitrogen. **It has much carbon content and less nitrogen.**

- Humus is not soluble in water.
- It is present in soil in the form of organic colloids.
- The amounts of humus in different soils vary greatly.
- Humus percentage in the soil is affected by climatic and biological factors.
- It is less in arid soils and very high in humid soils.
- In the top layer of the soil, humus quantity is greater than in the deep layers.

The humus may be found in the following three stages of degradation:

(i) **LITTER**: The top floor is covered with dead organic parts showing low degree of decomposition. These poorly decayed dead parts of plants form litter.

(ii) **DUFF**: Below the litter may be found a layer of partially decomposed organic matter which is known as duff layer.

(iii) **LEAF MOULD/HUMUS**: When the duff is decomposed completely into organic substances, the decomposition products, generally called leaf moulds, are accumulated below duff layer.

Sometimes under anaerobic conditions, the dead remains are not at all acted upon by the microorganisms. **Accumulation of such un-decomposed organic** remains is termed as **peat.**

Humus plays many important roles in the soil, such as:

(a) It makes the soil fertile.

(b) It provides nutrients to the plants and microorganisms.

(c) On complete decomposition, it forms several organic acids which serve as solvents for soil materials. Thus humus increases the availability of minerals in dissolved state to plants.

(d) Because it is porous, it has got high capacity for retaining water.

(e) Humus makes the soil porous, thus increases the aeration and percolation which make the soil more suitable for the plant growth.

(f) It also acts as weak cement thus binds the sand particles.

(g) Presence of humus in the soil increases the rate of absorption in plants.

The factors which influence the rate of humifications are outlined below:

(i) Nature of plants, animals or soil organisms.

(ii) Rate of decomposition.

(iii) Temperature (increase in temperature up to a certain limit increases the rate of humification).

(iv) Aeration and moisture. These increase the rate of humification.

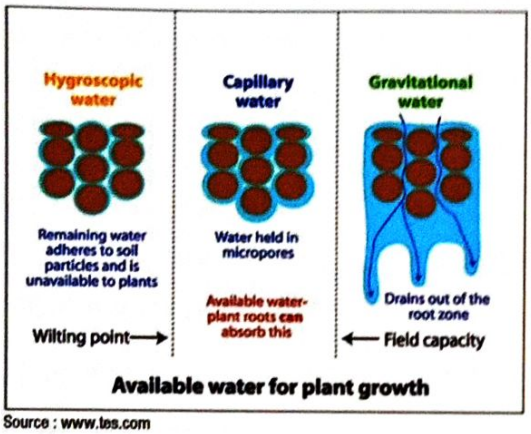
3. Soil Atmosphere: Air in soil pore, O_2, CO_2, and Nitrogen.

In the cultivated land, percentage of CO_2 is much higher than that of atmospheric CO_2, but oxygen content in such soil is poorer than the percentage of oxygen in atmospheric air.

The amount of CO_2 increases with the increase in depth of the soil due to decomposition of accumulated organic matter and abundance of plant roots.

4 Soil Water: means water present in soil.Water is held in the soil in the following forms:

(i) Gravitation water,
(ii) Capillary water,
(iii) Hygroscopic water,
(iv) Water vapour, and
(v) Combined water.

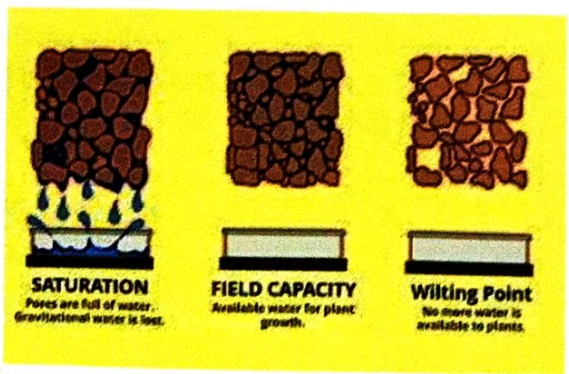


Source : www.tes.com

(i) Gravitational water: Excess water, percolates downwardly under gravitational force and reaches to the level of parental rock it is called ground water.

(ii) Capillary water: Water which is held by surface tension and attraction force of water molecules as thin film around soil particles in the capillary spaces is called capillary water. It moves in the direction where capillary tension is more. Capillary water is the main water that is available to plants.

(iii) Hygroscopic water:adsorbed on the soil particles and held on the surface of soil particles by forces of attraction and cohesion of its molecules.
(iv) Water vapour: present in the soil atmosphere in the vapour form.
(v) Combined water:water held by chemical compound. Eg. $CuSO_4.5H_2O$



Field Capacity: The amount of water present around the soil particles at saturation stage.

Wilting coefficient or permanent wilting percentage: Water lost from the soil surface by evaporation and through absorption by plants.The continuous loss of water may finally result in a stage at which water content of the soil becomes so poor as soil cannot supply water to growing plants rapidly enough to maintain them turgid. Under such conditions, permanent wilting occurs in the plants.

At permanent wilting stage ⇨ the percentage of moisture in the soil =wilting coefficient or permanent wilting percentage

5. Soil Microorganisms:

- Organisms present in the soils are called soil organisms. Important group of soil organisms are given below
- Flora: Algae, Bacteria (90% of total flora), Fungi,Actinomycetes.

  Bacteria: Neutral soil

  Fungi: Acidic soil

  Actinomycetes: Saline soil
- Fauna: Protozoa, Nematodes, Mites, Earthworm etc.

Role of Soil Organisms:

(1) Decompose the dead organic matter and increase plant nutrients in available forms,
(2) Production of toxins,egfusaric acid
(3) Production of growth stimulating substances,Fusarium species too have been found to secrete Gibberellin and Gibberellic acid ($C_{19}H_{22}O_6$).
(4) Nitrogen fixation in the soil,
(5) Mixing of soil,
(6) Improvement in soil aeration,
(7) Improvement in the aggregation of soil particles or soil binding, and
(8) Cause injury to the plants.

Howissoilformed?

Soilisformedwhenlargerocksbreakintosmallerpieces.Thesepiecesfurtherbreakintosandandsiltlomethisiscarriedtodifferentplacesbyrunningwaterandwind.Allthishoweverisaveryslowprocess.Ittakesthousandofyearstoformaverythinlayerofsoil.

Soil Analysis

Soil Testing: Its importance and benefits

In modern agriculture, soil testing is the most important practise to manage fertiliser application and crop production. Without soil testing, it is very difficult to ensure the right application of fertilisers for the crop and get the optimum yield.

What is soil testing?

The process by which elements such as phosphorus, potassium, calcium, magnesium, sodium, sulphur, manganese, copper and zinc are chemically removed from the soil and measured for their available content within the sample of soil is called Soil Testing. This is an important diagnostic tool for determining the nutrient for plants.

Soil Testing process at Harvesto's Soil Testing Lab

What are the objectives of soil testing?

The Objectives of Soil Testing are:

To evaluate the fertility and nutrient status of soil for providing an index of nutrient availability or supply in a given soil.

Determination of acidity, salinity and alkalinity problems.

To provide a recommendation on the amount of manure and fertilizer based on soil test value and according to crop.

To avoid excess use of fertilizer and to ensure environmental safety.

When crops are harvested, a considerable amount of nutrients are removed from the soil and causes loss of fertility in soil over a long period of time. So, the soil should be tested.

Evaluation of the suitability of the soil for the crop.

Restoration of soil fertility is a key factor for crop productivity, profitability and sustainability.

Fertilization programme must consider crop needs, soil supply, fertilizer use efficiency, the contribution from manures etc.

Time to time evaluation of the inherent soil fertility status is essential for arriving at the crop and site-specific balanced fertilization program to sustain productivity.

To Predict the probability of obtaining a profitable response to and fertilizers.

What are the benefits of soil testing?

Soil Analysis leads to more informed fertiliser decisions, reducing risks in the soil such as soil erosion, soil infertility and degraded lands and increasing farm profitability in the long-term.

Reveals the amount of plant-available macro-nutrients in the soil and where soil nutrients are in the soil profile

Identifies nutrients that could be yield-limiting

Monitors soil health properties such as pH, EC and OC, which affect nutrient availability to crops and thereby yields and profitability

Provides a basis for variable rate application (VRT) depending upon soil and crop.

Supports decisions about fertiliser rate, timing, placement and product.

Improved knowledge of the soil types within the farm to maximise management options.

Maximises in-season responsiveness.

Consequently, it also provides a farm management tool with a potential benefit to the farmer of increased yields, reduced operating costs and superior environmental risk management and it also includes improved crop maturity and quality, higher tolerance to disease and pest damage, and increased growth.

(Video: Benefits of Soil Testing)

Why should farmers get their soil tested?

It informs the farmer of the current health of the farm's soil and how to improve it

Soil fertility is determined by the soil's biological, chemical, and physical properties. Properties such as structure, soil texture, and colour are visible to the eye. However, it is hard to see the chemical composition of the soil. Therefore, there is a need for soil diagnosis and that's why soil sampling is critical. Soil tests are used to determine the soil's nutrient level and pH content. Armed with this information, farmers can define the quantity of fertiliser and the exact type that is needed for application to improve the soil on your farm. This is essential because fertile soils are necessary to grow healthy crops.

Soil test leads to minimisation of fertiliser expenditure

Knowing the exact deficiency of soil is experiencing will result in zero wastage of such farm inputs. The quantity and type of fertilisers of crops and soil need prevent farmers from wasting money on unnecessary extra fertiliser application. Moreover, nutrients such as potassium and phosphorus that are part of inorganic fertilisers are very limited resources. Their supply is limited or rather finite; implying that there is a need to be cautious in the usage to prevent a future shortage of such limited resources.

Soil testing results in limited over-fertilisation

Applying fertiliser to the soil without knowing the exact and actual nutrient that it needs will lead to over-fertilisation Overuse of fertiliser may be harmful not only to the environment but also it might cause fertiliser burn to the crops. Testing soil prior and receiving informed fertiliser recommendation prevents farmers from applying an excessive amount of fertilisers and minimising the related environmental damages. Over-fertilisation might result in water pollution, nutrient leaching, and irreversible harm to the aquatic life. Just a simple soil test can prevent all these negative environmental effects.

Farmers can easily avoid soil degradation

It is estimated from research that each year more than 24 billion tonnes of fertile soil is lost because of erosion which is caused by unbalanced soil management. Furthermore, land degradation directly affects the livelihoods and health of an estimated 1.5 billion people. Soil restoration is a costly, difficult, and time-consuming process. Therefore, better soil management through soil testing is an easier route to take, and application of the right amounts of fertilisers is efficient and financially justified.

Farmers with fertile soils can contribute to feeding the world's growing population

The importance of soil testing has been in existence since the early years. Different types of soils and variation in soil properties are important factors to note in farming. Soil texture, soil moisture, and soil chemistry are determinants of what crops can be grown and how much yield the farm can produce.

The current generation puts more pressure on the soil than ever before. There is a need for fertile soils to produce yields that will feed the world's ever-growing population. Improved soil health implies more crops, potentially closing the world's food security issues. This will eventually bring a better life to millions of people. Soil testing is the first step in soil management. The activity gives farmers valuable information that helps them improve the soil's health; healthy soils eventually imply healthy crops!

"Healthy soil is the foundation of a healthy crop and healthy farm."

What are the Soil Testing benefits for Farmers?

Soil testing provides plenty of benefits for farmers. Healthy soil improves crop growth. Farmers can begin testing their soil before harvest season to get a jump on how they can improve their soil. These benefits can help farmers by:

Improving yields and profitability because you are providing necessary nutrients to your crops.

Increasing consistency of nutrient availability across a field.

More uniform crop growth. This also helps individual plants stronger against weeds and simplifies other processes like cultivation and spraying.

More uniform plant maturity. This can help simplify crop harvesting and drying along with improving market quality.

Allowing fine-tuning of which nutrients are most needed. Helping you allocate your fertilizer dollars to those nutrients that will give you the greatest profit increase.

What are the Environmental Benefits of Soil Testing?

Soil sampling can also help the environment. Regular usage can wear out the land on which you grow your crops. The biggest impact soil testing has on environmental benefits mean:

More efficient use of plant nutrients means fewer losses from leaching or runoff into waterways.

Poorly nourished crops leave less plant residue to hold soil in place. Plant residue helps build soil and saves it from wind and water erosion.

Providing the right levels of nutrients helps increase yields and may help reduce the need for intensively farming marginal land.