**COMPOSITION OF SOIL**

Soil is a complex body composed of five major components. namely:

1. mineral matter obtained by the distintergration and decomposition of rocks;

2. organic matter, obtained by the decay of plant residues, animal remains and microbial tissues;

3. water, obtained from the atmosphere and the reactions in soil (chemical, physical and microbial);

4. air or gases, from atmosphere, reactions of roots, microbes and chemicals in the soil

5. organisms, both big (worms, insects) and small (microbes)

According to its size, soil can be separated into various fractions.

The clay fraction, because of its high surface area, is the most active part of the soil controlling many of the chemical and physical properties of the soil. It is the seat of soil fertility. The sand and silt fractions influence mainly the physical properties of the soil.

The inorganic component (mineral matter) of the soil is composed of many types of minerals which influence the properties of the soil. The differences among soils are due mainly to the differences in the type and relative abundance of such minerals. Minerals are naturally occuring inorganic compounds having definite crystalline structures. They are classified into primary and secondary minerals. Primary minerals are those formed at elevated temperature and inherited unchanged from igneous and metamorphic rocks whereas secondary minerals are formed at low temperature reactions and either inherited from sedimentary rocks or formed directly by weathering in soils.

Soil organic matter could be considered to consist of two general groups: (i) fresh or partially decomposed plant and animal residues having some recognisable physical structures traceable to its origin; and (ii) the humus, which is a more resistant product of decomposition and colloidal in nature. The black or brown colour usually observed in the surface layers of soil profiles is due to the presence of humus. Humus is the most reactive part of the organic matter. Its capacity to hold water and nutrients greatly exceeds that of clay, its inorganic counterpart. The fresh and partially decomposed plant and animal residues generally occur in the sand and silt fraction of the soil and the humus occurs in the clay fraction.

Soil moisture is the volumetric water content of soil held within the spaces the soil particles or soil aggregates. Soil moisture is of two types; surface soil moisture is the water present on the upper layer of soil, whereas root zone moisture is the water available to plants, generally present within the soil. The moisture of the soil is considered an indicator of the quality of soil and the fertility of the soil.

Soil gases are different types of gases that are present within the pores between soil particles or soil aggregates. The gases found in soil include carbon dioxide, oxygen, and nitrogen. Other atmospheric gases include methane and radon. Pores in the soil are filled by gases after the water present in such pores are evaporated absorbed by the root. In the case of environmental contaminants, soil gas might include gases diffused from landfill wastes, mining activities, and petroleum products.

Though Soil is composed of various factors like air, water, minerals, and different living and non-living organic compounds. The entire composition of soil can be classified as biotic and abiotic components; the abiotic component includes the non-living things of soil while the biotic component includes the living organisms.

In general, the abiotic component of the soil accounts for about 40-45% of the soil volume followed by air and water that occupy 25% each with 5% covered by living things. The exact composition of the soil, however, might vary from place to place with the existing rocks of the area and the climate. Other factors like the quantity of vegetation, soil compaction, and water retention capacity also influence the composition of the soil of a particular area. The inorganic part of the soil is composed of rocks that are slowly broken down into smaller particles that might vary in size. The organic component of soil is called the humus, which is made up of living organisms like insects or microorganisms (dead or alive) and dead animals and plants in varying stages of decay.



**Physical Composition of Soil**

Soil is composed of solids and spaces. Solids include soil minerals and organic matter; the spaces contain air and water. Ideally, the spaces should be composed of 50% air and 50% water. Soil tilth is good texture and drainage. Soil in good tilth holds water without becoming soggy and allows air to circulate to plant roots and soil organisms. Soil in good tilth allows roots to penetrate the soil easily and grow and is easy for gardeners to work.

Texture, structure and aggregation, density, drainage and water-holding capacity are important components of the physical characteristics of soil.

**Texture**

Texture refers to the proportions of sand (large particles), silt (medium particles) and clay (very fine particles) in the soil. The particles are loose sedimentary mineral material from fine clay particles to grains of sand and aggregates. Many of the traditional garden plants we are most familiar prefer loam soil, rich in humus. Loam contains from 7% to 27% clay, 28% to 50% silt and less than 52% sand. This would be ideal.

There are twelve main textural classes or groupings: clay, sand, silt, loam, sandy clay, sandy clay loam, sandy loam, loamy sand, clay loam, silty clay, silty clay loam and silty loam. Any extreme textural class is unfavorable for life.

Soil texture does not take organic matter into account, only the composition of clay, silt and sand in the soil. Adding organic matter does not change the texture of the soil.

**Drainage and Water Holding Capacity**

The drainage quality of soil is equally important. Soil drainage is the rate and extent of water and air movement in the soil either across the surface or downward. Soil that is soggy or water logged means there is not enough air in the soil pores or spaces. Many plants cannot live in this environment. Likewise, soils that drain quickly leach water and nutrients out of the soil.

**Chemical Composition of the Soil**

One of the three components of balanced soil is the chemical composition. For chemically balanced soil, the essential elements, both macronutrients and micronutrients need to be in balance, the pH of the soil should match the need of the plants, the salt content of the soil should be low, and the soil should be free of contaminants.

**Macro and Micro Nutrients**

It is important to have minerals balanced and available for use. Plants require sixteen essential elements for normal growth. Carbon, hydrogen, oxygen and nitrogen make up the top four elements. There are five more macronutrients— phosphorus, sulfur, calcium, potassium, magnesium and seven micronutrients or trace elements—boron, copper, iron, manganese, molybdenum, zinc and chlorine.

**Soil pH**

The soil pH is an important factor. The pH scale, from 1 to 14, is a measure of acidity or alkalinity of soil determined by the concentration of hydrogen ions in a water or salt solution. Acid soil would fall within the range of 1 to 7.0 pH, and alkaline soil from 7.0 to 14. Neutral soil has a pH of 7. The optimum pH range for growing plants is between 6.3 to 6.8, slightly acidic soil. This pH range is also ideal for most soil organisms and bacteria. In alkaline soils with a pH of 7.5 - 9.0, some macro and micro nutrients are not able to be absorbed. On the extreme alkalinity end, microorganisms are disrupted, interfering with the breakdown of organic matter and its release of nutrients from their action.

**Biological composition of soil**

Soil organisms are a very important part of soil. Soil micro and macro organisms are the link between soil nutrients and the plants. Microorganisms include bacteria, fungi, mycorrhizal fungi, nematodes, mites, actinomycetes, springtails, protozoas (amoebas, ciliates and flagellates). Macro organisms include insects, earthworms, crustaceans, sowbugs, arachnids, moles, gophers, prairie dogs, etc.

These are some of the organisms that make up the soil food web – the system that Supports plant growth, protects air and water quality, Ensures plant and human health by suppressing disease causing organisms, Sustains biological activity, diversity and productivity, Regulates the flow of soil water and dissolves nutrients in the soil, Stores and cycles nutrients and other elements and Filters, buffers, degrades, immobilizes and detoxifies organic and inorganic materials that are potential pollutants.

A complex soil food web will contain a diversity of organisms that competes with and prevents disease-causing organisms in many ways. The more complex the food web, the greater the biodiversity. The more biodiversity, the healthier the soil and plants will be. There are many species of the various micro and macro organisms, all with a specific job to perform. Some, but not nearly all, of their functions are photosynthesizing, decomposing, mycorrhizal associations, nitrogen fixing, and pathogen predators. all the microorganisms have specific functions. Bacteria and fungi have large roles to play in a healthy soil. Bacteria are necessary for plant growth on new fresh sediments. Bacteria “fix atmospheric nitrogen and carbon, produce organic matter and immobilize enough nitrogen and other nutrients to initiate nitrogen cycling process in the soil.”