Soil organisms and their beneficial effects

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The organisms which spend whole or part of their life in the soil are called soil organisms. Soil supports a wide variety of organisms of different body sizes and taxonomic groups. Generally soil organisms are classified into three major groups: micro, meso and macro-organisms.

Micro- organisms

These are too small and can be seen only with the aid of microscope having width less than 0.2 mm. It includes protozoa, small sized mites, nematodes, rotifers, tardigrades, crustaceans etc. Soil protozoa include amoebas, ciliates, flagellates, etc. Usually, protozoa thrive best in moist, well- drained soils, and are most numerous in soil surface. The nematodes such as *Rhabditis, Diplogaster, Heterodera, Mononchus, Pratylenchus* etc, are found more in soil.

The micro- flora of soil includes bacteria, soil fungi, soil actinomycetes, blue green algae, and algae. Among soil micro- flora bacteria form about 90% of the total population. Fungi and algae together represent 1% and actinomycetes about 9%.

Soil bacteria are classified into two groups, auto-trophic bacteria and heterotrophic bacteria. The auto-trophic bacteria obtain their energy from sunlight or from the oxidation of inorganic constituents such as ammonium, sulphur, iron etc. and obtain most of the carbon from carbondioxide or dissolved carbonates. The heterotrpphic bacteria depend upon the organic matter of soil for their energy source and are primarily concerned for the decomposition of cellulose and other carbohydrates, proteins, fats and waxes.

Most of the soil fungi are found in acidic soils. They may be parasitic, saprophytic, and symbiotic. Parasitic fungi of soil infect roots of plants, and cause plant diseases such as cotton root rot and many kinds of wilts, rusts, blight and smuts. Soil fungi comprise an extremely diverse group of micro organisms but for convenience of discussion, fungi may be divided into three groups: yeast, molds and mushroom.

Yeasts are single celled organisms, live principally in water logged anaerobic soils.

The molds are distinctly filamentous, microscopic or semi-microscopic fungi that play important role in soil organic matter breakdown. Molds develop vigorously in acidic, neutral and alkaline soils. The ability of molds to

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tolerate at low pH is especially important in decomposing the organic residue in acidic forest soils. The most common molds

which are found in soil are *Penicillium, Mucor, Fusarium* and *Aspergillus.*

The mushroom fungi are associated with forest and grass vegetation where moisture and organic residues are more. Although, the mushrooms of many species are extremely poisonous to humans, some are edible and few have been cultivated. Edible mushrooms are grown in caves and especially designed house where composted organic materials (particularly horse manures) provide their source of food.

Like the fungi, actinomycetes are filamentous and often profusely branched, though their mycelia threads are smaller than those of fungi. Actinomycetes are similar to bacteria in that they are unicellular and of about the same diameter. Actinomycete numbers in soil exceed those of all other organisms except bacteria.

The algae species are also found in soil, they range in size from 2-20 mili micron. Many algal species are motile and swim about in soil pore water, some by means of flagella. Several hundred species of algae have been isolated from soils but a small number of species are the most prominent in soils throughout the worlds. Soil algae are divided into three general groups: green, yellow green, and diatoms. The green algae are found in moist non flooded acidic soils, diatoms are numerous in neutral to alkaline well drained older gardens that are rich in organic matter. The important blue green algae are *Anaebaena, Nostoc, Mycrocystis, Oscillatoria* etc.

Meso- fauna

It includes the organisms with body size within the range of 0.2- 2mm with width. This includes arthropods like mites, collembola (springtails), Protura etc. The mesofauna also includes the larger nematodes, rotifers, and tardigrades together with most of the isopods, Arachnida, (spiders), chelognath (pseudoscorpions), opilions (harvestmen) ,enchytraeidae (pot-worms), insect larvae and small millipedes, (diplopoda) and molluscs.

Among annelids enchytraeids are represented by *Enchytraeus fridericia,* and *Achaeta lumbricellus,* which are more abundant in organic soils and forest than in grassland. *Onicus, Porcellis, Armadillidum* are the most common isopods, of the tropics in the humid zones. Among the soil arachnids, mites are predominant, certain mites such as *Glumna, Cephcus, Hemorobates* occur in lichens and mosses and some such as *schelorbates* and *Brachychthornus* live in humus.

The pseudoscorpions or chelognathi occur in surface soils and most decaying vegetation such as

Stenatemnus indicus , *Dhanus indicus*, *Fealla indica*, *Comsaditha indica*, *Tyrannochthonius madrasensis*, *Hygrochelifer indicus*, etc

The common millipedes or diplopodes of forest soil are *Spirostreptus*, *Thyropygus*, *Glomeris*, *Polydesmus*, *Iulis* etc. Tradigrades occur in surface layer of soils in grsslands like *Macrobiotus*, *Hypsibius* etc.

Among insects, apterygote collembola form numerically more in soil. Other insects such as Dermaptera, Psocoptera, Dictyoptera, Isoptera, Coleoptera, a few hymenoptera, and some diptera also occur in soil. The termites such as *Reticulotermes*, and *Odontotermes* are important soil dwellers of tropics. Among the hymenoptera, ants, are the most important soil dwelling forms. Among Diplura, *Anajapyx*, *Japyx* and *campodea* are often found in small numbers in moist soils under stones and humus.

Macro-fauna of soil

Macrofauna of soil includes the animals which have body size greater than 1cm. Macrofauna includes majority of lumbricidae, the mollusca, the largest insects, and arachnids, and the soil dwelling vertebrates Earthworms usually occur in abundance in alkaline moist soils. Some of the annelidan species of soils are *megascolex*, *Pheretima*, *octochaetus*, *Drawida*, *Moniligaster* etc. Among chilopods, *Scolopendra* and *Lithobius* are common in moist soils. Among soil vertebrates, some animals are well adapted for burrowing life in soils such as *Ichthyophis*, *Cacopus systema*, *Breviceps* (Amphibia), *Sphenodon*, *Uromastix*, limbless lizards, and snakes, (Reptilia), *Talpa*, *Dasyurus*, *Notoryctes*, and various insectivores, rodents etc.

Beneficial effects

The soil fauna and flora are indispensable to the plant productivity and the ecological functions of soils. Some of the beneficial effects are discussed here.

Organic material decomposition

The most significant contribution of soil fauna and flora is to decompose the dead remains of plants and animals. By the process of decomposition dead leaves, roots, and other plant tissues are breakdown, and make suitable for the use of plants. Soil organisms also assimilate wastes from animals and other organic materials added to soils. As a by- product of their metabolism, microbes synthesize new compounds, some of which help to stabilize soil structure and others of which contribute to humus formation.

Likewise, some micro-organisms, (bacteria and fungi) are helpful for the breakdown of toxic compounds. The detoxification activities are found more in surface layer of soil due to the presence of more organic matters and oxygen.

The transformation of inorganic compounds is of great significance to the

functions of soil systems, including plant growth. Organically bound forms of nitrogen, sulfur and phosphorus are converted by the microbes into suitable forms for the use of plants.

Similarly, the availability of the other essential elements, such as iron and manganese, is determined largely by microbial action. In well drained soils, these elements are oxidized by autotrophic organisms and changed into insoluble form. This keeps iron and manganese mostly in insoluble and non-toxic forms. If such condition did not occur, plant growth would be jeopardized because of toxic quantities of these elements in solution.

The fixation of elemental nitrogen gas which can not be used directly by higher plants,into compounds usable by plants is one of the most important microbial processes in soils. The actinomycetes fix major amounts of nitrogen in forest ecosystems, and cyanobacteria are important in flooded paddies fields, rhizobia bacteria are the most important group for the capture of gaseous nitrogen in agriculture soils. The greatest amount of nitrogen fixation by these organisms occurs in root nodules or in association with plants.

Plant protection

Certain organisms attack higher plants, but others act to protect plant root from invasion by soil parasites and pathogens , because certain soil bacteria , fungi and actinomycetes of soil produce antibiotics which kill the specific types of other harmful organisms.

Formation of humus by earthworms

Earthworm play significant role in soil formation. They may burrow 2 meters into the soil, make numerous transverse burrows and produce worm caste by eating the soil and soil organic matter. These castes are very rich in nitrogen and mineral substances and increases soil fertility. The burrows facilitate aeration and increases water holding capacity. Dash and patra (1979) measured 77 tonnes of dry weight of earthworm cast production per hectare per year in different world sites. In addition large amount of soil is deposited in burrows as casts. Earthworm cast contain more water soluble aggregates than the surrounding soils (Nijhawan and Kanwar,1952, Guild, 1955). A soil rich in aggregates remains well aerated and drained. Soil aggregate formation is of immense importance to soil fertility.

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