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SOIL MICROBIOLOGY

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ABSTRACT

Soil microbiology is concerned with the presence of micro-organisms in the soil and its impact on various aspects of agriculture and plant growth. Soil scientists and agricultural microbiologists identify the disease causing agents of crop plants and their control.

Scientific works on microbes can increase soil fertility and crop-yield, to study the effects of micro-organisms on farm cattle, and isolate such microorganisms, can be used as substitutes for chemical pesticides. Microorganism also play key roles in the cycling of important nutrients in plant nutrition, particularly carbon, nitrogen and sulphur. Microbial activities in soil and water convert these elements to forms that are readily accessible to plants.

Soil samples were collected from seven sites of the study area, sealed in sterilised plastic jars were sent to soil laboratory of Agriculture College Sabour for detailed examination and check of microorganism (microfauna and microflora) present in the soil.

The reports of the soil laboratory explain that microorganism have been classified on the basis of morphology shape and size, temperature, sensitivity, requirement of molecular oxygen, sources from which they derive carbon for body building and energy for the vital processes in the body.

THE MICROFLORA OF THE SOIL

The following are the major microflora in the soils.

(A) SOIL BACTERIA: Bacteria are primitive, very minute, unicelluar organism devoid of chlerophyll. They are simple in structure and consist of a mass of protoplasm surrounded by a semi permeable cell membrane. Soil Bacteria is of many types like Nitrogen fixing Bacteria, Nitrogen accumulating Bacteria and Ammoniating Bacteria etc.

Table 6.1

Number of bacteria, fungi and antinomycetes in soil

Soil Microorganism	Location	Number/g
Bacteria	a) Rhizosphere	6778×10^6
	b) Non-Rhizosphere	25×10^6
Fungi	a) Rhizosphere	918×10^3
	b) Non-Rhizosphere	68×10^3
Actinomycetes	a) Rhizospher	83×10^6
	b) Non-Rhizosphere	1×10^6

Some specific bacteria present in soil:-

(a) Nitrogen Fixing Bacteria: This group of bacteria in association with the root nodules of leguminous plants, fix molecular nitrogen from air and has been grouped under the genus Rhizobium. They reduce atmospheric nitrogen and make of available to plants.

(b) Symbiotic Nitrogen Fixing Bacteria: This group of nitrogen fixing bacteria in soil is classified under the genus Rhizobium. These heterotrophic aerobic microorganisms occur in the root region of legums and non-legumes.

(c) Non-Symbiotic Nitrogen Fixing Bacteria: Unlike the symbiotic nitrogen fixing bacteria, some living micro-organism are capable of fixing molecular nitrogen from air without any symbosis. There are Azobactor Chroocccum, Azobactor vinelandi and clostridium pasteurianum.

(d) Nitrogen Transforming Bacteria: Nitrogen is utilised by micro-organisms and higher plants in inorganic form as nitrate or ammonium. The nitrogen is drawn from organic matter present in soil or added as manures. The bacteria which are responsible for breaking down complex proteinous and mitrogenous organic compounds are ammonifiers or ammonifying bacteria. There are Nitrosomonas and Nitrobactor.

(e) Ammonifying Bacteria Or Ammenifiers: A few microorganism have the ability to utilise nitrogen from decomposition of nitrogen containing organic substances ammonium being a major product of this decomposition. Breakdown of protein and other nitrogenous substances is brought about by a number of bacteria, aerobic and an aerobic, and also to some extent by Actinomycetes and fungi.

In soil, the micro-organisms belonging to the genera Bacillus and Pseudomonas are mainly responsible for this transformation.

(f) Nitrifying Bacteria Or Nitrifiers: A few microorganisms are responsible for microbiological oxidation of Ammonium to nitrate. This process iscompleted in two stages (a) Nitrite formation (b) Nitrate formation.

The responsible bacteria are Nitrisomonous or Nitriate formers and Nitro bactor or nitrate formers.

(g) Denitrifying Bacteria Or Deni-Trifiers: Denitrification is the process by which nitrates are reduced to oxides of nitrogen and even to gaseous nitrogen.

The bacteria which are responsible for this transformation are called denitrifying bacteria or denitrifiers. There are mainly pseudomonas, Bacillus and Paracoccus.

(h) Cellulore Decomposing Bacteria Or Cellulolytic Bacteria: Decomposition of Cellulore, a major constituent of plant material and organic residues take place under aerobic and anaerobic conditions. The common cellulore decomposing bacteria belong to genus cytophaga, sporo cytophaga, Angio coccus and Polyangium.

(B) SOIL FUNGI: Fungi are heterotrophic plants larger than the bacteria. Those that live on dead tissues of organic substances are saprophytic. These play an important role in soil and plant nutrition. The number of fungi may vary from a thousand to a million or more per gram of soil. Certain Fungi or decomposers, during decomposition of dead tissues by fungi, a portion of plant nutrients in soil organisms is liberated in the form of inorganic substances which increase soil fertility. The important Fungi present in soil are phytomycetes, fungi imperfecti, penicillium and trichoderma.

(C) SOIL ACTINOMYCETES: Actinomycetes have characteristics which are transitional between bacteria and fungi and are sometimes called fungi like bacteria.

The streptomyces is the most common Actinomycetes present in soil. These may degrade all sorts of organic substances such as cellulose, polysaccharides, proteins, fats, organic acids etc. but the speed of degradation is slower than that of bacteria nad fungi.

(D) SOIL ALGAE: Soil Algae are microscopic chlorephyll certaining organisms being the simplest chlorophyllous plants.

Algae are phototrophic aerobic organisms, they obtain energy through chlorophyll from sunlight and fix atmospheric carbon di-oxide and synthesize their own food. These occur as unicellular organisms or as filamentous or as collonies on the surface sol, having adequate water content and receive sunlight.

Soil algae are cyanophyta (blue-green algae), chlorophytes (grass-green algae), Xanthophyta (yellow-green algae) and Bacillariophyta (golden brown algae or diatoms).

SOIL FAUNA

Soil fauna (Presence of animals) comprises of –

(a) Soil Macro fauna

(b) Soil Micro fauna

(a) Soil Macrofauna: In macrofauna the animals visible by naked dye are earthworm, moles, ants etc.

(b) Soil Microfauna: In Microfauna mainly protozoa, nematodes are present in the soil.

(c) Soil Viruses: Soil viruses are ultra-microscopic obligate parasites, always requiring a living host for their multiplication. They are much smaller than bacteria and can be observed only through an electro-microscope.

The viruses in soil are known as parasitize bacteria and specifically known as bacteriophages.

DISCUSSION AND RESULTS

The important role of soil micro-organism in the soil was recognised as early as 1838 when J.B. Boussingault, a French agricultural scientist, first observed that legumes could utilize, for their nutrition, nitrogen from atmosphere. This was further confirmed when M.W. Beijerinck, a Dutch Scientist, isolated bacteria from root nodules of legumes which were agents for nitrogen fixation. This was the first step of initiation of soil-microbiology as a branch of soil-science.

Biological-nitrogen fixation plays an important role in the economy of crop production. The pioneering investigations of a number of bacteriologists showed that soil is not an inert body, but a medium pulsating with life as a huge number of microbes are always viable and active.

At one time it was thought that the soil population consists of only bacteria. But later on, the presence of other microflora as natural habitants of soil was establishes. The microbes in this class of microflora are, bacteria, fungi, actinomycetes and algae.

Among these the bacteria are most abundant in soil, next in order are Actinomycytes, which is followed by Fungi.

Algae are generally found under specific conditions.

Cultural practices as cultivation, crop-rotation, application of manure's and fertilizers, liming and gypsum application, application of pesticides for crop

production have their effect on the soil-organism. Irrigation of soil brings about a significant proliferation of soil-microbes.

Fertilizers and manure applied to soil for increased crop production supply food and supply to crops and soil microbial population.

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