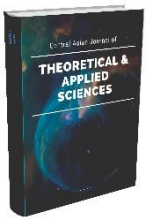

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Studies on Bacterial and Fungal Population in Different Soil Samples of Garden Area Shastripuram, Agra

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Abstract: *Soil contains many bacteria, fungi, algae, small plants, insects etc. The composition of the bacterial communities was closely defined by soil pH; there was as much variability in bacterial community composition across the 180-m distance of this liming experiment as across soils in this garden. The highest plate count of garden soil sample was bacteria such has Bacillus, &Pseudomonas,was dominating and fungi such as Cladosporium, & A.flavus were dominating of samples which were incubated at 20°C. The diversity of the total bacterial and fungal community was Streptococcus, Actinomycetes and S.pyogenes, S.coelicolor. Progressively lower counts were obtained in fungi as compared to bacteria in the garden samples of Shastripuram, Agra.*

Keywords: *Soil, Communities, Fungi, Bacteria, Shastripuram, Agra.*

INTRODUCTION

Soil microorganisms (Flora & Fauna), just like higher plants depends entirely on soil for their nutrition, growth and activity. The major soil factors which influence the microbial population, distribution and their activity in the soil are 1. Soil fertility 2. Cultural practices 3. Soil moisture 4. Soil temperature 5. Soil aeration 6. Light 7. Soil PH (H-ion Concentration) 8. Organic matter 9. Food and energy supply 10. Nature of soil and 11. Microbial associations.

All these factors play a great role in determining not only the number and type of organism but also their activities. Variations in any one or more of these factors may lead to the changes in the activity of the organisms which ultimately affect the soil fertility level. [1,2,3]

Variations in any one or more of these factors may lead to the changes in the activity of the organisms which ultimately affect the soil fertility level. Brief account of all these factors influencing soil micro flora / organisms and their activities is activities are discussed paragraphs.

1. Cultural practices (Tillage): Cultural practices viz. cultivation, crop rotation, application of manures and fertilizers, liming and gypsum application, pesticide/fungicide and weedicide application have their effect on soil organism. Ploughing and tillage operations facilitate aeration in soil and exposure of soil to sunshine and thereby increase the biological activity of organisms, particularly of bacteria. Crop rotation with legume maintains the favorable microbial population balance, particularly of N2 fixing bacteria and thereby improve soil fertility.

Liming of acid soils increases activity of bacteria and actinomycetes and lowers the fungal population. Fertilizers and manures applied to the soil for increased crop production, supply food and nutrition not only to the crops but also to microorganisms in soil and thereby proliferate the activity of microbes.[5,7,8]

Foliar or soil application of different chemicals (pesticides, fungicides, nematicides etc.) in agriculture are either degraded by the soil organisms or are liable to leave toxic residues in soil which are hazardous to cause profound reduction in the normal microbial activity in the soil.

2. Soil fertility: Fertility level of the soil has a great influence on the microbial population and their activity in soil. The availability of N, P and K required for plants as well as microbes in soil determines the fertility level of soil. On the other hand soil micro flora has greater influence on the soil fertility level.

3. Soil moisture: It is one of the important factors influencing the microbial population & their activity in soil. Water (soil moisture) is useful to the microorganisms in two ways i.e. it serve as source of nutrients and supplies hydrogen / oxygen to the organisms and it serve as solvent and carrier of other food nutrients to the microorganisms. Microbial activity & population proliferate best in the moisture range of 20% to 60%. Under excess moisture conditions / water logged conditions due to lack of soil aeration (Oxygen) anaerobic microflora become active and the aerobes get suppressed. While in the absence of adequate moisture in soil, some of microbes die out due to tissue dehydration and some of them change their forms into resting stages spores or cysts and tide over adverse conditions. Therefore optimum soil moisture (range 20 to 60 %) must be there for better population and activity of microbes in soil.

4. Soil temperature: Next to moisture, temperature is the most important environmental factor influencing the biological physical & chemical processes and of microbes, microbial activity and population in soil. Though microorganisms can tolerate extreme temperature (such as – 60 ° or + 60 u) conditions, but the optimum temperature range at which soil microorganisms can grow and function actively is rather narrow.

Depending upon the temperature range at which microorganisms can grow and function, are divided into three groups i.e. psychrophiles (growing at low temperature below 10 °C) Mesophiles (growing well in the temp range of 20 ° C to 45° C) and thermopiles (can tolerate temperature above 45° C and optimum 45-60°C).

Most of the soil microorganisms are mesophilic (25 to 40 °) and optimum temperature for most mesophiles is 37° C. True psychrophiles are almost absent in soil, and thermopiles though present in soil behaves like mesophiles. True thermopiles are more abundant in decaying manure and compost heaps where high temperature prevails.

Seasonal changes in soil temperature affect microbial population and their activity especially in temperate regions. In winter, when temperature is low (below 50° C), the number and activity of microorganisms falls down, and as the soils warms up in spring, they increases in number as well as activity. In general, population and activities of soil microorganisms are the highest in spring and lowest in winter season.[9,10,11]

5. Soil air (Aeration): For the growth of microorganisms better aeration (oxygen and sometimes CO2) in the soil is essential. Microbes consume oxygen from soil air and gives out carbon dioxide. Activities of soil microbes is often measured in terms of the amount of oxygen absorbed or amount of Co2 evolved by the organisms in the soil environment. Under high soil moisture level / water logged conditions, gaseous exchange is hindered and the accumulation of Co4 occurs in soil air which is toxic to microbes. Depending upon oxygen requirements, soil microorganisms are grouped into categories viz aerobic (require oxygen for like processes), anaerobic (do not require oxygen) and microaerophilic (requiring low concentration / level of oxygen).

6. Light: Direct sunlight is highly injurious to most of the microorganisms except algae. Therefore upper portion of the surface soil a centimeter or less is usually sterile or devoid of microorganisms. Effect of sunlight is due to heating and increase in temperature (More than 45°)

7. Soil Reaction / Soil PH: Soil reaction has a definite influence / effect on quantitative and qualitative composite on of soil microbes. Most of the soil bacteria, blue-green algae, diatoms and protozoa prefer a neutral or slightly alkaline reaction between PH 4.5 and 8.0 and fungi grow in acidic reaction between PH 4.5 and 6.5 while actinomycetes prefer slightly alkaline soil reactions. Soil reactions also influence the type of the bacteria present in soil. For example nitrifying bacteria *(Nitrosomonas & Nitrobacter)* and diazotrophs like *Azotobacter* are absent totally or inactive in acid soils, while diazotrophs like *Beijerinckia, Derxia,* and sulphur oxidizing bacteria like *Thiobacillus thiooxidans* are active in acidic soils.

8. Soil Organic Matter: The organic matter in soil being the chief source of energy and food for most of the soil organisms, it has great influence on the microbial population. Organic matter influence directly or indirectly on the population and activity of soil microorganisms. It influences the structure and texture of soil and thereby activity of the microorganisms.[12,13,15]

9. Food and energy supply: Almost all microorganisms obtain their food and energy from the plant residues or organic matter / substances added to the soil. Energy is required for the metabolic activities of microorganisms. The heterotrophs utilize the energy liberated during the oxidation of complex organic compounds in soil, while autotrophs meet their energy requirement form oxidation of simple inorganic compounds (chemoautotroph) or from solar radiation (Photoautotroph). Thus, the source of food and energy rich material is essential for the microbial activity in soil. The organic matter, therefore serves both as a source of food nutrients as well as energy required by the soil organisms.

10. Nature of Soil: The physical, chemical and physico-chemical nature of soil and its nutrient status influence the microbial population both quantitatively and qualitatively. The chemical nature of soil has considerable effect on microbial population in soil. The soils in good physical condition have better aeration and moisture content which is essential for optimum microbial activity. Similarly nutrients (macro and micro) and organic constituents of humus are responsible for absence or presence of certain type of microorganisms and their activity. For example activity and presence of nitrogen fixing bacteria is greatly influenced by the availability of molybdenum and absence of available phosphate restricts the growth of *Azotobacter.*

11. Microbial associations / interactions: Microorganisms interact with each other giving rise to antagonistic or symbiotic interactions. The association existing between one organism and another whether of symbiotic or antagonistic influences the population and activity of soil microbes to a great extent. The predatory habit of protozoa and some mycobacteria which feed on bacteria may suppress or eliminate certain bacteria. On the other hand, the activities of some of the microorganisms are beneficial to each other. For instance organic acids liberated by fungi, increase in oxygen by the activity of algae, change in soil reaction etc. favors the activity or bacteria and other organisms in soil.

12. Root Exudates: In the soil where plants are growing the root exudates also affects the distribution, density and activity of soil microorganism. Root exudates and sloughed off material of root surfaces provide an abundant source of energy and nutrients and thus directly or indirectly influence the quality as well as quantity of microorganisms in the rhizosphere region. Root exudates contain sugars, organic acids, amino acids, sterols, vitamins and other growth factors which have the profound effect on soil microbes.[17,18,19]

The garden soil samples of Shastripuram, Agra were collected from 4cm depth. Soil profile where most of the microbial activity takes place, and thus where most of the bacterial population is concentrated. Soil samples were collected (approx100g) in clean, dry and sterile polythene bags using sterilized spatula.

The samples were processed using soil dilution plate method. One gram of soil sample was serially diluted with sterilized distilled water upto 10-1, 10-2, 10-3, 10-4, 10-5 10-6, 10-7 And 1ml of each dilution was added to 20ml of nutrient agar medium in 90mm diameter sterile Petridishes and then enumerated.

The sample is expansion on the sterilized pour plate method. The lids are replaced and after solidification. The agar plates are incubated 30°C for 24 -48 hrs in bacterial, and fungal colony forms counter and expressed as CFU $\times 10^7$ /g. Data represented in the table. Statistical analysis The result obtained in the present investigation was subject to statistical analysis present for mean and standard deviation by following the method for one-way ANOVA in SPSS 16.0 version. The bacteria and fungi count of all treatment shows significant at $p<0.05\%$ level

DISCUSSION

Soil is alive. Much more than a prop to hold up your plants, healthy soil in a garden of microbes eating and pooping and reproducing their way toward glorious soil fertility.

A single teaspoon (1 gram) of rich garden soil can hold up to one billion bacteria, several yards of fungal filaments, several thousand protozoa, and scores of nematodes

Most of these creatures are exceedingly small; earthworms and millipedes are giants, in comparison. Each has a role in the secret life of soil.

Bacteria make up the largest group in the soil garden, and they are as diverse as they are numerous. Some kinds of bacteria are responsible for converting atmospheric nitrogen to plant-available forms, a process known as nitrogen fixation. Actinomycetes, with cells like bacteria and filaments like fungi, are thought to contribute chemicals that give newly tilled soil its earthy aroma.

Mycorrhizae are fungi that form a relationship with plant roots and increase their ability to take up nutrients from the soil. These filaments, along with root hairs and other binding substances produced by bacteria and fungi, help hold soil particles together and keep soil from eroding.

Protozoa are single-celled, mostly motile organisms that feed on bacteria and other tiny organisms as well as each other. There may be thousands of them living in that teaspoon of soil. Protozoa release nitrogen, making it available to plants. As much as 80 percent of the nitrogen in plants can come from bacteria-eating protozoa.

Nematodes, simple roundworms, have evolved several feeding strategies. In temperate soils, some eat bacteria while others eat fungi or soil algae. Some nematodes attack plants, piercing plant cells and sucking out the contents. Some nematodes eat other nematodes or other small invertebrates.

Earthworms, giants of the soil garden, mix and aggregate soil particles, creating deep channels that help aerate the soil and provide channels for growing roots. They shred and bury plant residue that stimulates microbial activity and increases the soil's capacity to retain moisture. Earthworms consume tiny soil organisms and excrete even more microorganisms in their castings.

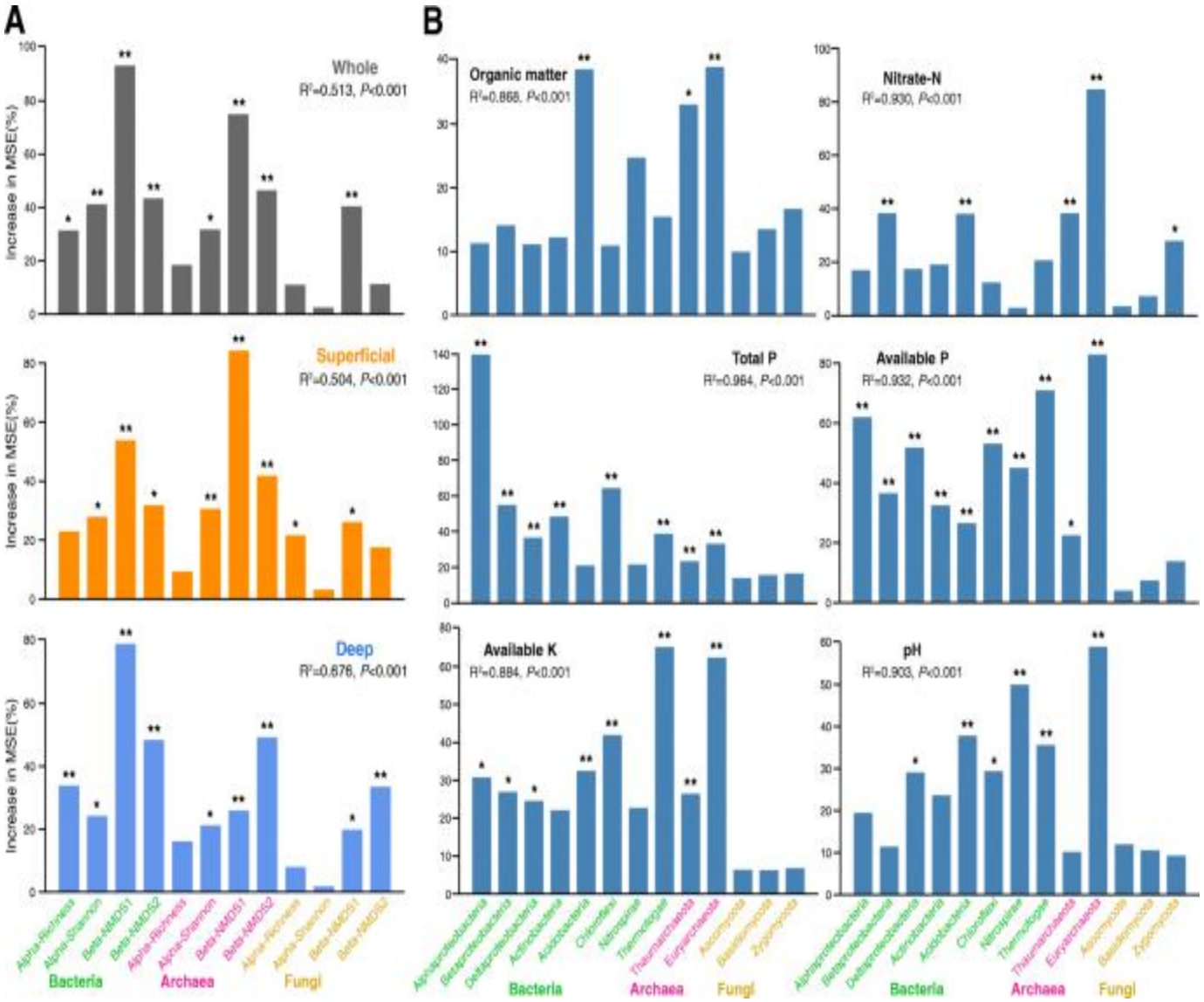
The base of the soil food web is organic matter, material derived from living stuff that provides a source of energy stored as fixed carbon. Nutrients are "served" along with fixed carbon as carbon is converted to energy. Chemical fertilizers supply specific nutrients directly to plants, but they do not replace the other kinds of food that bacteria and fungi need. Soils with more organic matter tend to have more life.

Mulching with compost, cover cropping and no-till farming practices tend to increase organic matter and thus increase the number and diversity of microorganisms in soil.[20,21,22]

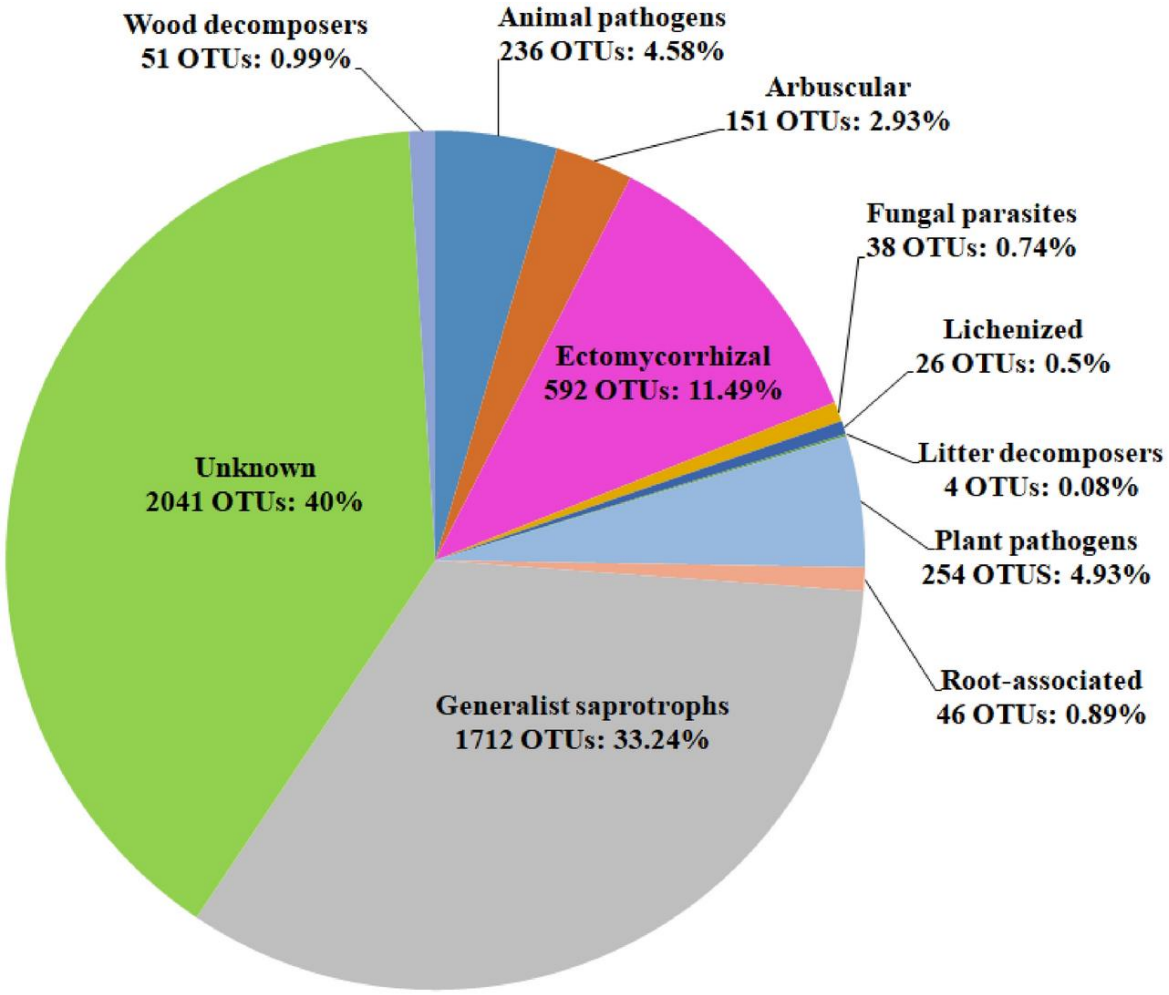
"All these things that live in the soil may seem unimportant, "but they work together in a system that is truly the foundation of life."

RESULTS

The highest plate count of garden soil sample was bacteria such has *Bacillus*, & *Pseudomonas*, was dominating and fungi such as *Cladosporium*, & *Aspergillus flavus* were dominating of samples which were incubated at 20°C. The diversity of the total bacterial and fungal community was *Streptococcus, Actinomycetes and Streptococcus pyogenes, Streptococcus coelicolor*. Progressively lower counts were obtained in fungi as compared to bacteria in the garden samples of Shastripuram, Agra [21,22]



Garden soil containing maximum bacteria, second archea and third fungi in plate counting graphs shown upto 10^{-7}



Soil of Shastripuram garden in Agra, containing different pathogens, lichens, fungi, bacteria, decomposers, saprotrophs etc

CONCLUSIONS

The highest plate count of garden soil sample was bacteria such has *Bacillus*, & *Pseudomonas*, was dominating and fungi such as *Cladosporium*, & *Aspergillus flavus* were dominating of samples which were incubated at 20°C. The diversity of the total bacterial and fungal community was *Streptococcus*, *Actinomycetes and Streptococcus pyogenes*, *Streptococcus coelicolor*. Progressively lower counts were obtained in fungi as compared to bacteria in the garden samples of Shastripuram, Agra[23]

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