

Importance of Microbes in Sustainable Agriculture

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SUMMARY

In sustainable agriculture the use of organic manures are beneficial for soil health and to maintain microbial population in soil. Microbes, especially fungi, bacteria and algae are commonly found in soil and water. Some of them are harmful which causes a diseases in crop plant and in human also. But some microbes are beneficial which helps for decomposition of organic matter in soil, improving soil structure, insect and disease control, weed management, production of biofertilizers / antibiotics and industrial products. The use of biopesticides / biofertilizers minimizes or reduced the application chemical substance for crop pest control, provide eco-friendly plant disease management strategies.

INTRODUCTION

A microbes or microorganism is a microscopic, which may be a unicellular or multicellular organism, especially fungi, bacteria, algae etc. Microbes are commonly found in soil, water, high in atmosphere and deep inside rocks. Microbes are very important or vital to humans as well as environment. They participate in many processes, especially decomposition of organic matter, recycling of old plant material, Fermentation processes and many more. In agriculture microbes plays an important role in plant growth promoting and acts as antagonistic agent for many devastating pathogen which cause harmful diseases in crop plants. Not all microbes or microorganism which are present in environment are beneficial, some of which are harmful and causes diseases in crops as well as in humans. Microbes (bacteria, fungi) which are present in soil plays important role in decomposition and recycling of organic matter. Some beneficial soil microbes are involved in the process of nutrient transformation. Some important species of bacteria (*Bacillus* sp, *Pseudomonas* sp produces phytohormones or enzymes which help to protect plants from plant pathogen attack and promoting healthy growth of crop plants. The microbes can also used to produce many organic compound (acids) and foods and beverages in industry.

Importance in Sustainable Agriculture:

1) Improving soil fertility:

The microorganisms present in soil, especially bacteria and fungi plays an important role in improving soil structure by decomposing organic matter or crop / animal residues present in soil and provide humus to the soil. Some microbes can fixes atmospheric nitrogen in root nodules of legumes and maintain sufficient amount of nitrogen in soil and provide available form of nitrogen to the plants. They convert atmospheric nitrogen (N₂) into ammonium (NH₄⁺) form.

eg. Biological nitrogen fixation in legumes, Bacteria- Rhizobia and Bradyrhizobia and Actinomycetes in non-leguminous crops.

2) Nutrient management:

Soil microbes help to plants to absorb more nutrients from soil and in return plants can give waste by products to microorganism as a food material. The phosphate and nitrogen which are very important for crop growth and development but plant cannot extract them easily. Some microbes present in soil having ability to release phosphate from the soil by making organic acid which dissolves the phosphate from the soil so that plant roots can easily absorb them. eg. Fungus - *Penicillium bilaii*.

In rhizospheric region many interaction takes place in between the plant roots and soil microbes and determine symbiotic association or mycorrhizal association between them which is beneficial for both of them. eg. Symbiotic- Rhizobium (Atmospheric Nitrogen fixation)

3) Microbes as biofertilizer:

The bio-fertilizer plays an important role in crop growth, their production and maturity, biotic and abiotic stress tolerance, disease and pest tolerance etc. The biofertilizer is a substance which containing living microbes or microorganisms. Biofertilizers can be applied or used for seed treatment and soil application.

They colonize rhizospheric region or interior portion of the plant and promote growth of the plants. Bio-fertilizers add nutrients through the processes of biological nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances. With the use of bio-fertilizers the use of chemicals fertilizers is reduces. The microorganisms present in bio-fertilizers recycle and build soil organic matter. With the use of bio-fertilizers improving the sustainability and the fertility of the soil. Some of the examples of biofertilizers,

1)N₂ fixing biofertilizers-

Free living- Azotobacter, Clostridium.

Symbiotic- Rhizobium, Frankia.

2)P Solubilizing biofertilizers-

Bacteria- Bacillus circulans, Pseudomonas striata

Fungi- Penicillium sp, Aspergillus awamori

4) **Microbes as biopesticides / bioherbicides:**

In agriculture, use of chemical substances for controlling crop pest and to manage weeds is very costly and causes pollution in environment. Microorganisms play important role in controlling or inhibiting the growth of crop pest and weed also. The use of biopesticides / bioherbicides to control crop diseases, insects, nematodes and weeds are environment friendly method. The most common biopesticides which can be used for controlling crop pest / weeds as follows, fungal and bacterial biopesticides (Trichoderma spp., Pseudomonas spp., Bacillus spp.), bioinsecticides (Bacillus thuringensis, Pandora delphacis, Beauveria bassiana), bioherbicides (phytophthora palmivora, Colletotrichum gloeosporoides, fusarium lateritium, Alternaria cassiae) etc.

5) **Production of antibiotics:**

The antibiotics is a secondary metabolites produced by microorganism which can kill or inhibit growth of pathogen or regulating the microbial population.

eg. Penicillium notatum (Penicillin), Bacillus, Streptomyces.

6) **Production of plant growth regulators:**

Microbes which are living in rhizospheric region of plants synthesize and release plant growth regulators or phytohormones (Auxin, Cytokinins). The species of Bacillus produces exopolysaccharides which protects plants from plant pathogens. The species of Pseudomonas produces secondary metabolites viz., antibiotic, siderophore and hydrogen cyanide which help to suppress many plant pathogen. The Pseudomonas fluorescens can also helps to plants as both protection from pathogens and promoting crop growth.

7) **Microbes as biotic elicitors:**

Biotic elicitors are the compounds which is derived from fungal or bacterial organisms which are used for enhancing the production of secondary metabolites from plants and plays an important role in plant defense mechanism. They are formed by the action of microbes on plant cell walls viz., fragments of pectines. Some biotic elicitors are component of pathogen cell wall viz., chitin or chitosan, beta glucans.

8) **Importance of microbes in industry:**

The microorganism can be used to produce many organic compounds, foods and beverages and enzymes etc. Some of beneficial microorganism can be used in industrial microbiological work.

1)Acids- Citric acid, Gluconic acid- Molds- Aspergillus niger, Lactic acid- Bacteria- Lactobacillus bulgericus

2)Vitamins- Vit. B12- Pseudomonas streptomyces (Bacteria), Vit. B2- Ashloya gossypii (Molds)

3)Enzymes- Amylase- Aspergillus oryzae, Pectinase- Clostridium sp.

4)Beverages- Wine- Yeast- Saccharomyces cerevisiae, Vinegar- Acetobacter

CONCLUSION

Microbes or microorganism, especially fungi and bacteria are very important in sustainable agriculture for maintaining soil fertility or structure, healthy growth of crop plants by providing them nutrients from soil and

protection from many harmful pathogens. By the use of biofertilizers / biopesticides can reduce chemical use, cost of farming, environmental pollution and provide effective eco-friendly management against crop pest.

REFERENCES

- Dube H. C. An introduction to fungi. Third edition, Vikas publishing house pvt. ltd., New Delhi. 2005.
- Jangra, M. R., Jangra, S and Nehra, K.S. (2018). Role of microbes in agriculture. Crop improvement for sustainability. pp. 192-222.
- Singh, JS. Plant growth promoting rhizobacteria potential microbes for sustainable agriculture. Resonance. 2013. pp. 275-281.
- Singh, S., Singh, V. and Pal, K. (2017). Importance of micro organisms in agriculture. Climate and environmental changes: Impact, challenges and solutions. pp. 93-117.
- Sonia S., Kumar, R. and Gupta, S. (2013) Antibiotic production by microbes isolated from soil. *Int. J. Pharmaceutical Sci. Res.* 4 (8) - 2967-2973.

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