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Sustainability "an evoking concern"-role of fungi

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In the 21st century, sustainability has emerged as an evoking concern specifically if we talk about agriculture production.

Sustainability is defined as" system which involves unified usage of plant and animal practices which have site-specific applicability that would remain longer" to fulfill the requirements of food and shelter and improve environment quality the use of non-renewable resources is most effective. Recently it is estimated that the world population would reach up to 9 billion in the year 2050 so feeding this increasing population by using limited land area is the most challenging situation.

Due to excessive usage of fertilizers, pesticides, insecticides have deteriorated the soil fertility status and have caused many environmental issues so recent researches are focusing on investigating the approaches which can be alternative to chemical inputs. Regarding these aspects, microbes are being explored to improve soil fertility status. More importance is given to consider the role of native soil microbes which contribute to soil fertility, enhance crop production, and protect the plant against pests and diseases. By inoculation of Beneficial microbes such as plant growth-promoting bacteria (PGPR), fungi, cyanobacteria in soil, or plant system crop production can be enhanced and it would step towards sustainability.

A fungus is eukaryotes comprises of different single-celled or multi-celled species possibly of beneficial or pathogenic nature. In past decades fungi are used inoculated alone or in combination with bacterial specie for various purposes. There are different kinds of fungi exploited for use in sustainable agriculture includes filamentous, endophytic, arbuscular mycorrhizal fungi (AMF), etc

The filamentous fungus helps to degrade organic matter in soil and improves soil aggregation ability. Certain species *Alternaria, genus Aspergillus, Cladosporium, Dematium, Gliocladium, Humicola, and Metarhizium produce* organic substances in the soils system which maintain soil organic matter (SOM).

Endophytic fungi by infecting plant parts without harming plant lives in mutual relation with it. This association of fungi with crop plant will result in an increment of plant growth by improving nutrient acquisition as well as stress tolerance ability including metal, disease, drought, heat, etc

The use of **AM fungi** in sustainable agriculture is increasing due to its wider distribution in soil and its significant contribution to microbial biomass and soil nutrient cycling process in plants. Nutrient uptake such as phosphorous, copper, zinc, and growth promotion substances are improved by its usage.

There are different roles of fungi which are being exploited for sustainable agriculture which includes:

- Use of fungi as bio-fertilizer
- Use of fungi as a bio-pesticide
- For remediation of metal contaminated sites

Use of fungi as bio-fertilizer

Bio-fertilizers are defined as formulations containing living microorganisms that are applied to the plant, soil, and seed and result in supply in essential nutrients required for plant growth. They are considered environmentally friendly and cost-effective technology which builds the fertility status of soil and ultimately promotes plant growth.

Recently the yeast application as bio-fertilizer has gained much attention due to its safety to humans and our environment. Wide usage of brewer's yeast *(Saccharomyces cerevisiae)* as bio-fertilizer which is the by-product of the brewing industry is seen which has increased availability

of N and P to roots and shoots of tomato and sugarcane plants.

Use of fungi as a bio-pesticide

It has been reported that plant diseases have decreased plant productivity from 20% to 40% around the globe. So, it is dire need to work in this area to enhance the potential of crops against pests and diseases. As the use of pesticides always has hazardous impacts on our surrounding so the use of biological inputs such as fungus is an attractive and emerging approach.

For remediation of metal contaminated sites

Heavy metal contamination beyond the threshold limit is an environmental problem and gaining much public attention. There are 5 million soil pollution sites covering 500 million ha of land around the globe contaminated with heavy metals. Due to rapid industrialization, undue usage of chemical inputs, and high population growth heavy metals are built-in soil systems and by there uptake by plant system it is being entered into the food chain. Different approaches are being used for remediation of contaminated sites such as physical, chemical, and biological. The use of physio-chemical approaches is not only expensive but also has many limitations regarding its usage so biological approaches are more preferred and safer. Due to the wider range of adaptability the fungi act as a major reservoir. Many researches are carried out to know how the fungus community is used in remediation to attain sustainability and quality food production. Different species of fungi *Irpex lacteus, P. ostreatus and P. chrysosporium* have been investigated for their potential to degrade heavy metals.

CONCLUSION

Recently, it is dire need to devise an approach that is eco-friendly, cost-effective to increase agricultural production to achieve this purpose fungal communities are being exploited and explored due to their role in growth promotion through solubilization of nutrients and production of various substances such as phytohormones. Keeping in view the above discussion many researches are carried out in the past and will be carried in the future to achieve our foremost goal “sustainability”.