

**Periodical Seminar on**  
**“Beneficial Microbes and their Role in Forestry”**  
**Delivered by**  
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Microbes being the first evolved living forms of the planet have been influencing the life processes of all other living systems and have become an integral part of the entire biosphere. Because of the advantage of their ubiquitous presence, minute size and astonishingly rich physiological qualities, they play a key role in maintaining the biological equilibrium on the biosphere. In the prolonged and continuing process of co-existence, plants, animals and microbes have developed certain inter-relationships, which can be differentiated as associative, antagonistic, commensalistic, mutualistic, pathogenic and symbiotic.

In agriculture, excessive use of chemical fertilizers has led to several environmental problems including reversal of soil micro flora, depletion of essential nutrients and eutrophication of aquatic sources. To overcome these problems in Agriculture and Forestry, bio-fertilizers are the solutions as they are natural, beneficial and eco-friendly. Bio-fertilizers contain beneficial microorganisms, which will increase the mineral nutrients availability in soil and will help the crop plant in breakdown of organic matter, N<sub>2</sub> fixation, and secretion of growth substances. The beneficial microbes also provide nutrients to the plants, control root and soil borne diseases, prevent the attack from root pathogens and maintain over soil nutrient quality. Their uses are very much considered as important for raising healthy and quality seedlings in tree nurseries, because, the soils used to raise seedlings in nursery are generally low in nutrients and lack of different beneficial microbial populations. Hence, it is very essential to improve the seedling health and quality of every forest tree species at the nursery level for better out planting performance in the field. Also, application of bio-fertilizers in tree nurseries is cost effective which will otherwise reduce the use of costly chemical fertilizers.

Mycorrhizas are symbiotic associations between plant roots and soil fungi that play a key role in nutrient cycling in the ecosystem and also protect plants against environmental stress. This association is usually considered as a mutualistic symbiosis because of the fact that both the host root and fungus sacrifice some of their independence and form a unity with structural integration and functional compatibility (symbiotic effectiveness) that controls the metabolism of plant and fungus alike. The host plant receives mineral nutrients via fungal

mycelium (mycotrophism), while the heterotrophic fungus obtains carbon from the host plants. This fungus becomes an integral part of the root system of host and thereby gets an ecologically protected habitat. There are different types of mycorrhizal fungi viz., Ectomycorrhiza, Ericoid Mycorrhiza, Orchid Mycorrhiza, Vesicular Arbuscular Mycorrhiza (presently named as Arbuscular Mycorrhiza), Arbutoid Mycorrhiza and Monotropoid Mycorrhiza. Mycorrhizal symbiosis is an important factor in the establishment of seedlings in the reclamation and rehabilitation of degraded lands. The most common mycorrhizal fungi used in forestry practices are (i) Ectomycorrhizal (ECM) and (ii) Arbuscular Mycorrhizal (AM) fungi.

Plant Growth Promoting Rhizobacteria (PGPR), Nitrogen fixing bacteria (*Frankia*, *Rhizobium*, *Azospirillum*, *Azotobacter*), Phosphate solubilizing bacteria (*Bacillus*, *Pseudomonas*) and Mycorrhizal fungi (ECM and AM) have been isolated and used for the growth and biomass improvement of both exotic and native tree species in tree nurseries by IFGTB. The outcome of those research works are being disseminated to the stake holders such as State Forest Departments, Forest Development Corporations, Wood based industries, Tree growers and Farmers. However, novel bio-fertilizer isolates/strains in micro nutrient solubilization, nitrogen fixation and phosphorus solubilization are yet to be identified. Further, reclamation and rehabilitation of polluted, degraded, saline and mined out areas by using potential bio-fertilizers with suitable tree crops are need to be studied. Regionally important indigenous tree crops are to be improved through application of effective bio-fertilizers and method of inoculation techniques has to be standardized. Cost effective bio-formulations of different bio-fertilizers either in solid or liquid form with sufficient infective propagules have to be developed and also the bio-fertilizer production facilities have to be established for sustainable production and supply of different bio-fertilizers to various stake holders.



