**SE-1: BIOFERTILIZERS AND BIOPESTICIDES**

**Unit 4 Mycorrhizal Biofertilizers**

Mycorrhizae (fungus root) is a distinct morphological structure which develops as a result of mutualistic symbiosis between some specific root-inhabiting fungi and plant roots. The symbiotic association between fungi and root systems of higher plants come under the genral names ‘fungus roots’. Fungus roots were discovered by the German botanist Frank.

There are three kinds of mycorrhiza-

By earlier mycologists the mycorrhiza were divided into following three group-

a). Ectomycorrhizae b). Endomycorrhizae c). Ectendomycorrhizae

a). Ectomycorrhizae-

* It is found among gymnosperms and angiosperms.
* The ectomycorrhizae are characterized by the presence of an external pesudoparenchyma sheath, called *mantle*, on the terminal nutrient absorbing rootlets. The sheath may be more than 40µm thick, any may constitute up to 40% of the dry weight of combined (root+fungus) structure.
* Beneath the sheath, the fungal hyphae penetrate the intercellular spaces of epidermis and cortex to form an intercellular network of hyphae called *Hartig net.* Though the hyphae of the Hartig net are in close contact with the root cells in the region, there is no penetration of host cells.

b) Endomycorrhizae –

* Endomycorrhiza are found in all groups of plant kingdom.
* In endomycorrhiza, the fungal partner grows mainly inside the roots, penetrating the outer cortical cells of the plant root. Only a small portion of the fungal component lies externally as a loose mass of hyphae in soil.
* The morphology of endomycorrhizal roots, after infection and establishment, remain unchanged

c) Ectendomycorrhizae-

* In the roots of some of the gymnosperms and angiosperms, ectotrophic fungal infection occur.
* Hyphae are established intracellulary in cortical cells. Thus, symbiotic relation develops similar to ecto- and endo- mycorrhizae.

**Arbuscular mycorrhizae-** also known as *Vesicular Arbuscualr mycorrhizae* (VAM). About 70-90% of land plant species form AM associations. These include angiosperms,gymnosperms, pteridophytes and barophytes. Most of the crop plants like maize, wheat, beans, tomatoes, tea, coffee, sugarcane, cotton etc form AM. Fungi belonging to seven genera i.e., *Glomus, Acantospora, Gigaspora, Entrophospora, Archaeospora, Paraglomus* and *Scutellospora* enter into AM associations.

As compared to ectotrophic mycorrhizae, the AM fungi neither form any mantle nor cause any visible changes in the roots. These are visible only when root tissues are appropriately stained. A network of intercellular as well as intracellular hyphae is seen. The hypahe upon penetrating cortical cells, form very fine structures showing tree-like branching. These structures are called *arbuscles.* These are thought to be major sites of the nutrient exchange between the fungal and plant partners. Apparently, these look similar to the haustoria of biotrophic parasites. But, *arbuscles* do not have neck, and have a very limited life. The arbusclues are surrounded by a plant-derived membrane called *periarbuscular membrane* (PAM). The interface between the fungal plasma membrane and PAM is called *periarbuscular space* (PAS). PAS contain fungal and plant cell wall material. Some (but not all) AM fungi produce vesicles and were, therefore, called *vesicular arbuscular mycorrhizae* (VAM).

**Mass production and filed application of VAM**

VAM can be produced on a large scale by pot culture technique. This require host plants, mycorrhizal fungi and natural soil. The hospt plants which support large scale production of inoculums are strawberry, sorghum, maize, onion, citrus etc.

The starter inoculums (spores) of VAM can be isolated from soil by wet sieving and decantation technique. VAM spores are surface sterilized and brought to the pot culture. Commonly used pot substrate are sand: soil (1:1, w/w) with a little amount of moisture. An outline for inoculums production is given in Fig 20.7

**Field application of ectomycorrhizae-**

1. **MYCOGROE-**
* MYCOGROE is a tabletted form of mycorrhizae inoculums which conatins spores of ectomycorrhizae mixed in sterile soil as a carrier. It contains no chemicals and is natural product, beneficial for both plants and soil. It is ideal for pines, eucalyptus and casurina species.
* In established seedlings, the MYCOGROE is placed 1 to 1.5 inch deep away from the base of the seedlings
1. **Mycobeads-**
* Mycobeads are hydrogel bead inocula of ectomycorrhizal fungi first developed by Tommercup *et al.* (1987). The mycelium of ectomycorrhizal fungi is immobilised in hydrogel beads are being used in Australia.
* The beads are 2mm diameter and kept under axenic condition in sterile deionised water at 4°C until used. The beads remain viable for 6 months. The fungal mycelium intiate mycorrhizae within 5-10 days and its efficacy has been found very effective for *Eucalyptus spp.*
* In established seedlings, the Mycosbeads is placed 1 to 1.5 inch deep away from the base of the seedlings

**Benefits of mycorrhizae to plants**

* They increase the longevity of feeder roots, surface area of roots by forming mantle and spreading mycelium into soil and in turn, the rate of absorption of major and minor nutrients from the soil resulting in enchanced plant growth.
* They play key role for selective absorption of immobile (P,Zn and Cu) and mobile (S, Ca, K, Fe, Mn, Cl, Br and N) elements to plants. These are available to plants in less amount.
* VAM fungi enchance water uptake in plants
* VAM mycorrhizae reduce plant response to soil stress such as high salt levels, toxivity associated with heavy metals, mine spoils, drought and minor elements imbalance.
* VAM decrease transplant sock to seedlings. They produce organic “glue” which bind soil particles into semistable in aggregates. Thus, they play a significant role in augmenting soil fertility and plant nutrition.