SEMESTER-3
SEC-A: Unit - 4
MYCORRHIZAE

❖ Introduction:

Mycorrhiza (fungus roots) is a distinct morphological structure which develops as a result of mutualistic symbiosis between some specific root - inhabiting fungi and plant roots. Plants which suffer from nutrient scarcity, especially P and N, develop mycorrhiza *i.e.* the plants belong to all groups *e.g.* herbs, shrubs, trees, aquatic, xerophytes, epiphytes, hydrophytes or terrestrial ones. In most of the cases plant seedling fails to grow if the soil does not contain inoculums of mycorrhizal fungi. In recent years, use of artificially produced inoculums of mycorrhizal fungi has increased its significance due to its multifarious role in plant growth and yield, and resistance against climatic and edaphic stresses, pathogens and pests.

❖ Mechanism of Symbiosis:

The mechanism of symbiosis is not fully understood. Biorkman (1949) postulated the carbohydrate theory and explained the development of mycorrhizas in soils deficient in available P and N, and high light intensity. Slankis (1961) found that at high light intensity, surplus carbohydrates are formed which are exuded from roots. This in turn induces the mycorrhizal fungi of soil to infect the roots. At low light intensity, carbohydrates are not produced in surplus therefore, plant roots fail to develop mycorrhizas.

❖ Types of Mycorrhizas:

By earlier mycologists the mycorrhizas were divided into the following three groups:

***(i)* Ectomycorrhiza.** It is found among gymnosperms and angiosperms. In short roots of higher plants generally root hairs are absent. Therefore, the roots are infected by mycorrhizal fungi which, in turn, replace the root hairs (if present) and form a mantle. The hyphae grow intercellularly and develop Hartig net in cortex. Thus, a bridge is established between the soil and root through the mycelia.

***(ii)* Endomycorrhiza.** The morphology of endomycorrhizal roots, after infection and establishment, remain unchanged. Root hairs develop in a normal way. The fungi are present on root surface individually. They also penetrate the cortical cells and get established intracellulary by secreting extracellular enzymes. Endomycorrhizas are found in all groups of plant kingdom.

(***iii)* Ectendomycorrhiza.** In the roots of some of the gymnosperms and angiosperms, ectotrophic fungal infection occurs. Hyphae are established intracellularly in cortical cells. Thus, symbiotic relation develops similar to ecto- and endo-mycorrhizas.

Marks (1991) classified the mycorrhizas into seven types on the basis of types of relationships with the hosts:

(i) vesicular-arbuscular (VA) mycorrhizas (coiled, intracellular hyphae, vesicle and arbuscules present),

(ii) ectomycprrhizas (sheath and inter-cellular hyphae present),

(iii) ectendomycorrhizas (sheath optional, inter and intra-cellular hyphae present),

(iv) arbutoid mycorrhizas (seath, inter-and coiled intracellular hyphae present),

(v) monotropoid mycorrhizas (sheath, inter- and intra- cellular hyphae and peg like haustoria present),

(vi) ericoid mycorrhizas (only coiled intracellular hyphae, long coiled hyphae present), and

(vii) orchidaceous mycorrhizas (only coiled intracellujlar hyphae present).

Type *(i)* is present in all groups of plant kingdom; Types *(ii)* and *(iii)* are found in gymnosperms and angiosperms. Types *(iv)*, *(v)* and *(vi)* are restricted to Ericales, Monotropaceae and Ericales respectively. Types *(iv)* and *(v)* were previously grouped under ericoid mycorrhizaes.

Types: *(vii)* is restricted to Orchidaceous only.

❖ Methods of Inoculum Production and Inoculation:

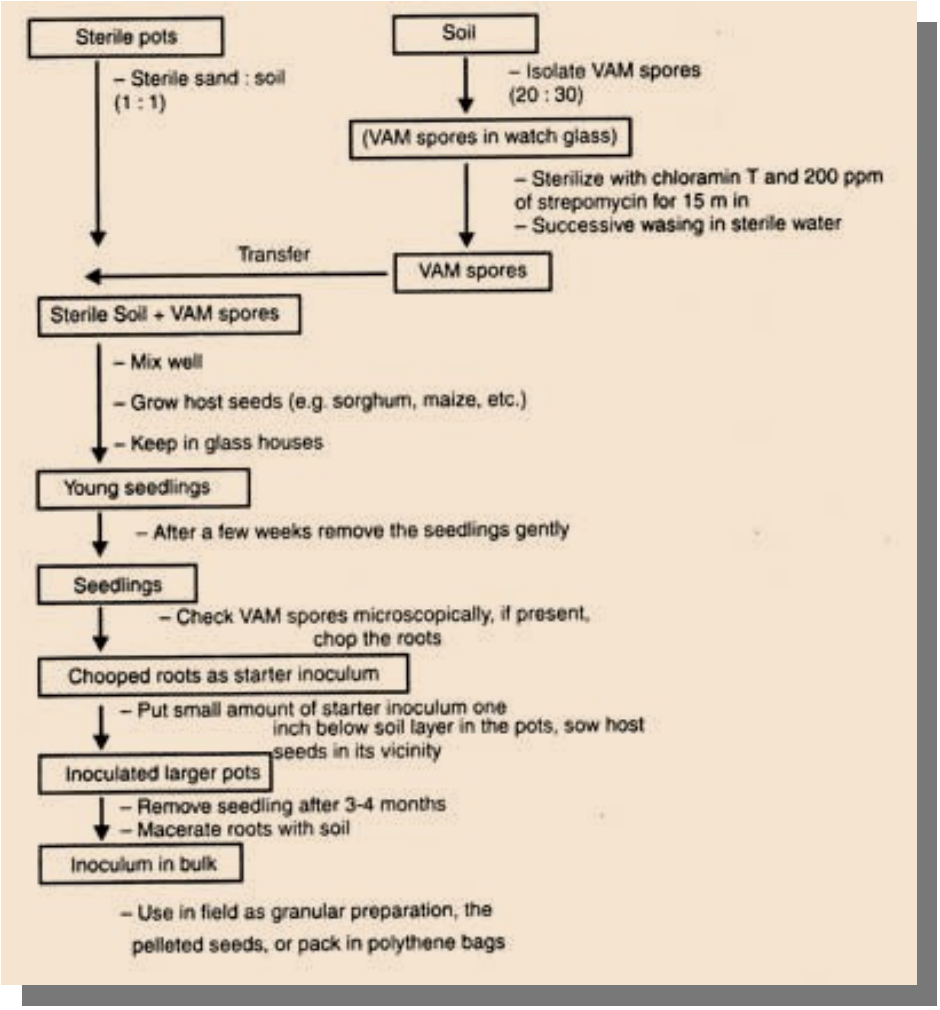
Methods of inoculum production of VAM fungi differ; however, some of these two are briefly described here.

(a) **Ectomycorrhizal fungi:** The basidiospores, chopped sporocarp,

sclerotia, pure mycelia culture, fragmented mycorrhizal roots or soil from mycorrhizosphere region can be used as inoculum. The inoculum is mixed with nursery soils and seeds are sown.

***(b)* VA mycorrhizal fungi:** VA mycorrhizas can be produced on a large scale by pot culture technique. This requires the host plants, mycorrhizal fungi and natural soil. The host plants which support large scale production of inoculum are sudan grass, strawberry, sorghum, maize, onion, citrus, etc.

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



There are two methods of using the inoculum :

(i) using a dried spore-root-soil to plants by placing the inoculum several centimetres below the seeds or seedlings,

(ii) using a mixture of soil-roots, and spores in soil pellets and spores adhered to seeds with adhesives.

Commercially available pot culture of VA mycorrhizal hosts grown under aseptic conditions can provide effective inoculum. Various types of VA mycorrhizal inocula are currently produced by Native Plants, Inc (NPI), Salt Lake City. In India, Forest Research Institute, Dehra Dun has established mycorrhizal bank in different states of the country. Inocula of these can be procured as needed and used in horticulture and forestry programmes.

❖ Benefits from Mycorrhizas to Plants:

(i)	They increase the longevity of feeder roots, surface area of roots by forming mantle and spreading mycelia into soil and, in turn, the rate of absorption of major and minor nutrients from soil resulting in enhanced plant growth.
(ii)	They play a 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 fewer amounts.
(iii)	Some of the trees like pines cannot grow in new areas unless soil has mycorrhizal inocula because of limited or coarse root hairs.
(iv)	VA mycorrhizal fungi enhance water uptake in plants.
(v)	VA mycorrhizal fungi reduce plant response to soil stress such as high salt levels, toxicity associated with heavy metals, mine spoils, drought and minor element *(e.g.* Mn) imbalance.
(vi)	VA mycorrhizal fungi decrease transplant socks to seedlings. They

	produce organic 'glues' which bind soil particles into semi stable in aggregates. Thus, they play a significant role in augmenting soil fertility and plant nutrition.
(vii)	Some of them produce metabolites which change the ability of plants to induce roots from woody plant cuttings and increase root development during vegetative propagation.
(viii)	They increase resistance in plants and with their presence reduce the effects of pathogens and pests on plant health.

Can you explore something more?