

## Quadrant II – Transcript and Related Materials

**Programme:** Bachelor of Science (First Year)

**Subject:** Botany

**Course Code:** BOC 101

**Course Title:** Biodiversity I (Microbes, Algae, Fungi and Bryophytes)

**Unit:** Fungi

**Module Name:** Mycorrhiza- Ectomycorrhiza and endomycorrhiza and their significance

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### Notes

#### Introduction to mycorrhiza

Mycorrhiza is a symbiotic association between hyphae of certain fungi and roots of plants. About 80-90% of all land plants are mycorrhizal. The term 'mycorrhiza' was coined by Frank in 1885.

Symbiotic association leads to mutual benefit between the two partners. While the plant roots provide excellent habitat for the growth of fungi, it also provides nourishment. Fungi, on the other hand, assists the plant in mineral and water uptake, protects the plant roots from pathogenic attack and improves plant fitness.

#### Types of mycorrhizae

Mycorrhizae can be broadly divided into two types depending on the extension of hypha in the roots and their colonization pattern. These are ectotrophic and endotrophic mycorrhizae. Endotrophic mycorrhiza can be further divided into arbuscular mycorrhizae (AM), Ericoid mycorrhizae and Orchidoid mycorrhizae.

However, there are two other types of mycorrhizae (Arbutoid and Monotropoid) that show both ectotrophic and endotrophic behaviour. They are therefore called as the ectendomycorrhizae.

### **Ectomycorrhiza**

Ectomycorrhiza is also called 'sheathing mycorrhiza'. It is characterized by the presence of external pseudoparenchymatous sheath called 'mantle' on the terminal nutrient absorbing rootlets. Beneath the sheath, hyphae penetrate the intercellular spaces of outer cortex to form a network called the 'Hartig net'. The colonized rootlets branch repeatedly to form a cluster. Root hair formation is suppressed and the function of absorption is instead done by the fungal hyphae which grow into the soil from the mantle.

Ectomycorrhizae occur in 3% of plant species (mostly conifers and broad-leaved trees of temperate and boreal forests). About 5000 species of fungi have been recorded to be involved in ectomycorrhizal association. These mainly belong to Basidiomycota. Some Ascomycota members are also reported.

Ectomycorrhizae do not exhibit high host specificity. Therefore, species of different fungi may be present in the root system of a single tree.

### **Endomycorrhizae**

Endomycorrhizae is characterized by the penetration of cortical cells (of plant roots) by fungal hyphae. Only small proportion of the fungus lies externally as a loose mass of hyphae in the soil.

1. Arbuscular mycorrhizae (AM)- Arbuscular mycorrhizae was earlier called Vesicular Arbuscular Mycorrhizae (VAM). It is the most common type of mycorrhizae found worldwide. About 70-90% of all plants (angiosperms, gymnosperms, pteridophytes and bryophytes) form AM associations. Major crops also form AM associations.

The fungal partners in AM associations are Zygomycota members and belong to genera- *Glomus*, *Sclerocystis*, *Gigaspora*, *Entrophospora*, *Acaulospora*, *Archaeospora*, *Paraglomus* and *Scutellospora*.

AM fungi are obligate biotrophs. Although the spores germinate in the absence of host, they need the host to complete their life cycle. But AM fungi do not show much host specificity. Any AM fungus can colonize any plant. Also, a single plant may be colonized by more than one AM fungi. AM fungi do not form any mantle. Instead, they form a network of inter- and intracellular hyphae. They also produce arbuscules and vesicles in the cortical cells.

Arbuscules: Arbuscules are tree-like branching structures which form the major site of nutrient exchange. They are surrounded by plant-derived periarbuscular membrane.

Vesicles: Vesicles are spherical or oval, lipid-rich storage structures produced by only some AM fungi.

AM fungal hyphae extend from the colonized roots and branches out in the soil. This is called extra radical hyphae. It produces spores. These are involved in further root colonization.

2. Ericoid mycorrhizae- Ericoid mycorrhizae is a type of mycorrhizae in which the plant partner is some species of order Ericales. This plant group has delicate hairy roots that lack root hair and has ephemeral epidermis. The fungal partners of ericoid mycorrhizae are mostly basidiomycetes but some ascomycetes are also seen.

The difference between ericoid mycorrhizae and arbuscular mycorrhizae is that in ericoid mycorrhizae not arbuscules are formed. Instead, the fungal hyphae branches in most cortical cells to form only coils or knots.

3. Orchidoid mycorrhizae - Orchidoid mycorrhizae is a type of mycorrhizae in which the plant partner is an Orchid. Since orchid seeds are small and lack endosperm, they germinate only when colonized by fungi. Fungal partner in orchidoid mycorrhizae are

some basidiomycetous members. Important genera involved are *Rhizoctonia*, *Armillaria*, *Fomes*, *Marasmius* and *Corticium*.

The characteristic feature of orchidoid mycorrhizae is that the fungi penetrate the outer cortical cells to form coils called pelotons. The plant cells secrete enzymes to breakdown these pelotons and utilize the nutrients brought by the fungus.

### **Significance of mycorrhizae**

1. Improves root system growth- Mycorrhizae helps in faster plant establishment. It increases absorption area of root by about 50 times. This also leads to overall increase in the plant biomass and increases plant vigour.
2. Provides phosphate to the plant- Through its extensive hyphal network, the fungus influences the physiochemical properties of the soil and increases the solubility of phosphate, absorbs it and makes it available to the plant.
3. Improves plant efficiency in nutrient uptake- The hyphae absorb and directly deliver nutrients to roots. In more acidic soils, where litter decomposition is slow, mycorrhizae (ericoid) obtain nitrogen from organic sources in the soil by protease enzyme action and delivers it to the plant.
4. Protects plant roots from pathogens- The mycelium acts as a mechanical barrier and reduces the chances of contact of pathogen with the root. It also induces changes in root exudates which alters root interaction with soil microorganisms.
5. Protects the plant during water scarcity- During water scarcity, when the roots shrink, mycorrhizal hyphae bind the roots to the soil and maintain water continuity. Also, the hyphae absorb water and directly delivers it to the root cortical cells.
6. Protects plants from toxic effects of pollutants- Toxic pollutants in the soil are absorbed, accumulated and immobilized in the mycelium, thus preventing the plant roots from absorbing it.

7. Helps in the distribution of photosynthates between plants- Hyphae extends to connect plant roots of same or different species and serves as a channel for distribution of photosynthates between plants. Certain habitats with high species richness have some plants 'nursing' the others through mycorrhizal mycelium.

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