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CONTENTS

- Introduction
- Types of mycorrhizae
- Mycorrhizal biofertilizer
- Applications of mycorrhizae
- Conclusion
- References

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Introduction :

- *Mycorrhizae* are mutualistic symbiotic associations formed between the roots of higher plants and fungi.
- It is an Greek word, mykes: mushroom or fungi; rhiza: root.
- Fungal roots were discovered by the German botanist A B Frank in the last century (1855) in forest trees such as pine.
- In nature approximately 90% of plants are infected with mycorrhizae. 83% Dicots, 79% Monocots and 100% Gymnosperms.
- Convert insoluble form of phosphorous in soil into soluble form.

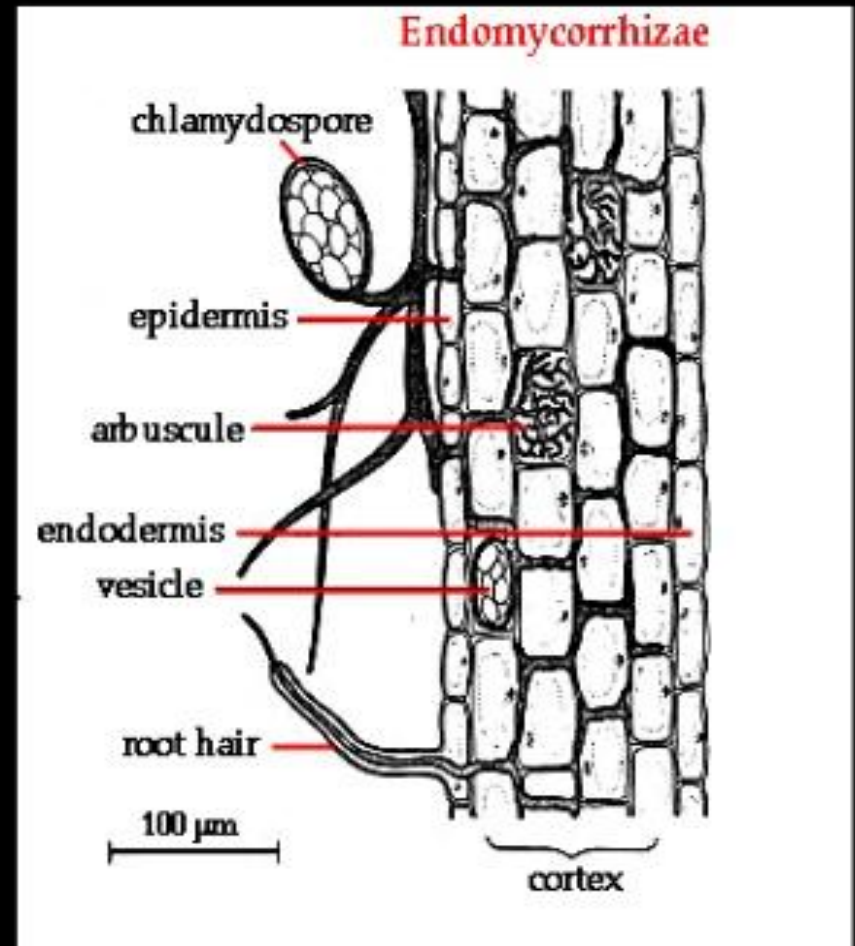
Types of mycorrhizae :

- On the basis of morphological and anatomical features, mycorrhizae are divided into the three types.
 1. Endomycorrhizae
 2. Ectomycorrhizae
 3. Ectendomycorrhizae

- Endomycorrhizae further classified in to five types.
 1. VAM fungi (vesicular arbuscular mycorrhizae)
 2. Orchidoid mycorrhizae
 3. Monotropoid mycorrhizae
 4. Ericoid Mycorrhizae
 5. Arbutoid mycorrhizae

Endomycorrhizae :

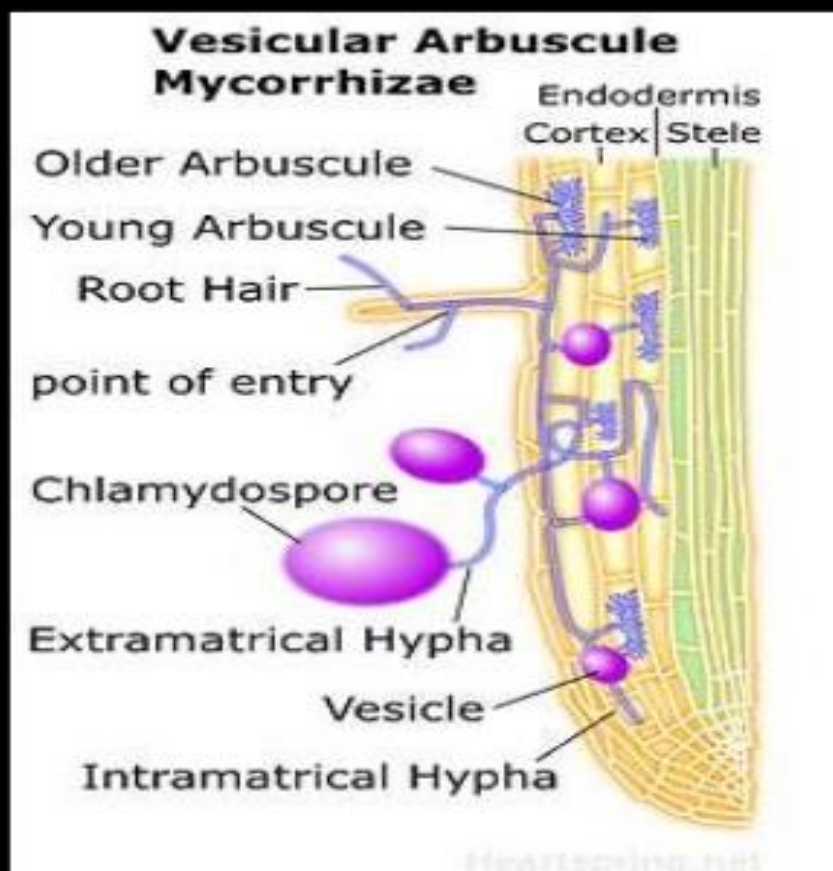
- It is a mycorrhizal association in which the fungal hyphae are present on root surface as individual threads that may penetrate directly into root hairs, other epidermal cells & into cortical cells.



VAM fungi (Vesicular Arbuscule mycorrhizae) :

- Fungi formed VAM association with plants may belongs to ascomycetes , basidiomycetes and zygomycetes.

- All VAM fungi are obligate biotrophic, as they are completely dependent on plants for their survival.



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Orchidoid Mycorrhizae :

- Fungi belongs to basidiomycotina and colonize only member of family orchidaceae. This association is probably pseudomycorrhizal but play an important role in establishment of orchid seedlings.

Ericoid Mycorrhizae :

- Fungal members are usually basidiomycetous and Ascomycotina. This is found in roots of plants belonging to order ericales. Rootlets are covered by a loosely woven mesh of dark brown septate hyphae from which branches penetrate the cortical cells.

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Monotropoid Mycorrhizae :

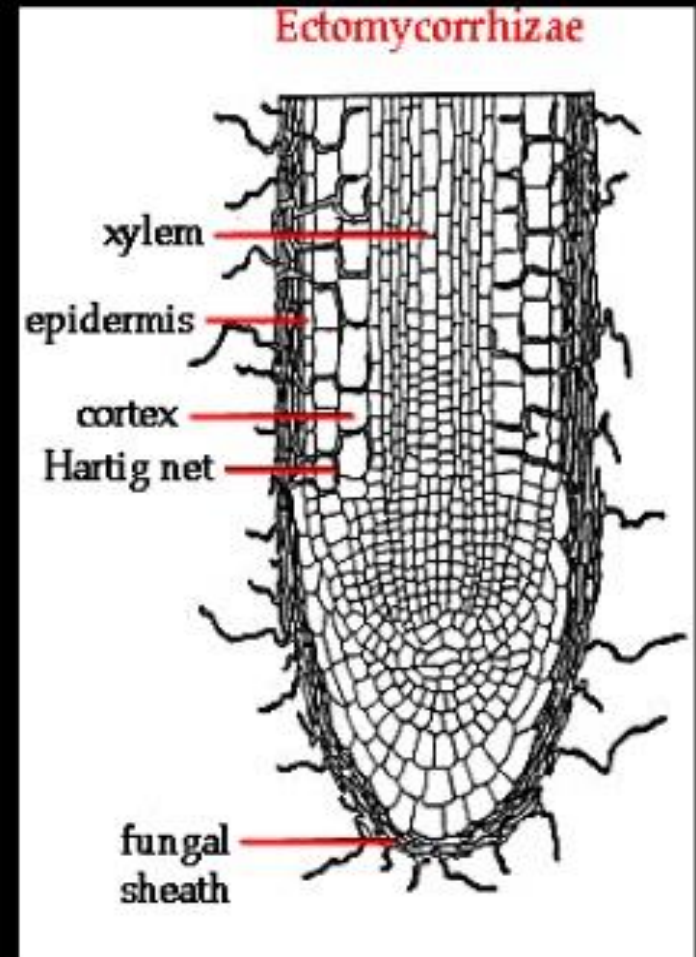
- The fungi belong to basidiomycotina, colonizing achlorophyllous members of angiosperms belonging to family monotropaceae. Fungal sheath present.

Arbutoid Mycorrhizae :

- Arbutoid mycorrhizal associations are variants of ectomycorrhizae found in certain plants in the ericaceae characterized by hyphae coils in epidermal cells.
- A major difference between the arbutoid and ectomycorrhizal association is that the hyphae of the former actually penetrate the outer cortical cells and fill them with coils.

Ectomycorrhizae :

- Ectomycorrhizae (ECM) are association, where fungi form a mantle around roots. There is no hyphal penetration of cells. Fungal hypha is generally separate. A distinct Hartig's net is present between the cells.



Ectendomycorrhizae :

- The fungi belong to Basidiomycotina, which covers both gymnosperms and Angiosperms plants. Ectendomycorrhizae show many of the same characteristics' of Endomycorrhizae but also show extensive intercellular penetration.
- The formation of Ectendomycorrhizae begins with formation of a hartig's net, which grows behind the apical meristem of the growing root. The hartig net penetrates between the epidermal and outer cortical cells and later extends to the inner cortex.

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Mycorrhizal biofertilizer :

i. Isolation

- a. Sieving method
- b. Flootation method

ii. Mass production

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i) A) Sieving method :

Soil sample + sterile water



Hot water



Filter and sieve



(719 μ m \rightarrow 250 μ m \rightarrow 50 μ m \rightarrow 45 μ m)



Spores separated from soil particles



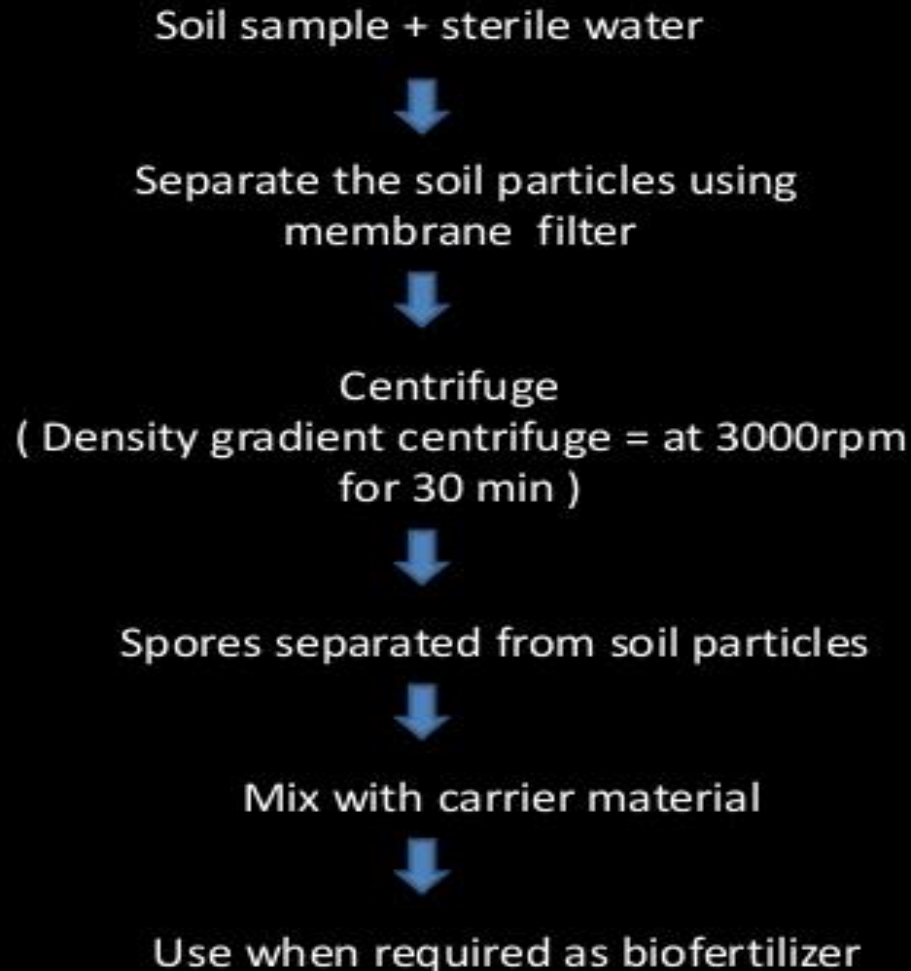
Mix with carrier material



Use when required as biofertilizer

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B) Floatation method :



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ii) Mass production :

Spores + antibiotic solution
(streptomycin of 220 ppm concentration for 15 min)



Wash spores with mercuric chloride



Wash with distilled water



Inoculate the plant pots (Guinea grass or Bahiya
grass)



Keep in green house for 3 - 4 weeks

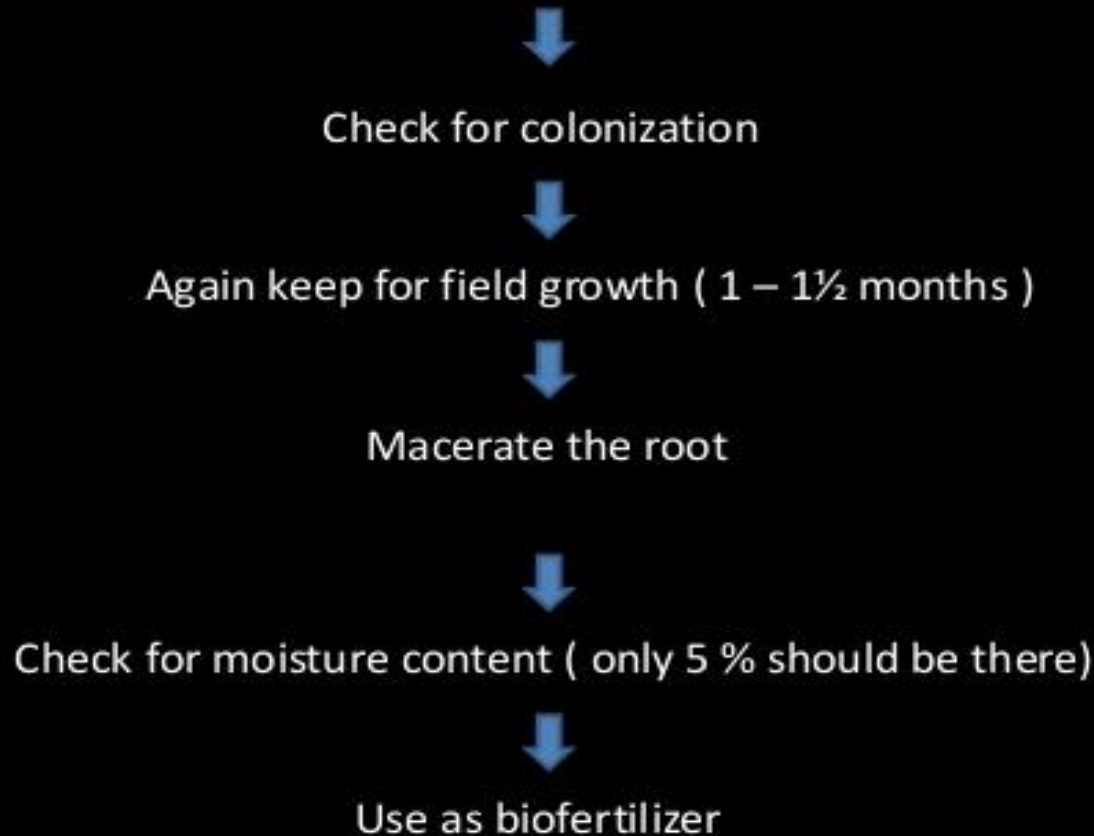


Uproot the plants

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Applications of Mycorrhizae :

- Increase nutrient uptake of plant from soil.
 - P nutrition and other elements: N, K, Ca, Mg, Zn, Cu, S, B, Mo, Fe, Mn, Cl
- Increase diversity of plant.
- Produce uniform seedling.
- Significant role in nutrient recycling.
- More tolerant to adverse soil chemical constraints which limit crop production.
- Increase plant resistance to diseases and drought.
- Stimulate the growth of beneficial microorganisms.
- Improve soil structure.
 - Stable soil aggregate – hyphal polysaccharides bind and aggregate soil particles.

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- Increases absorption of phosphate by crops.
- uptake of zinc also increases.
- Increases uptake of water from soil.
- Increases uptake of sulphur from the soil
- Increases the concentration of cytokinins and chloroplast in plants.
- They protect plants during stress condition.

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Conclusion :

Mycorrhizal association is very essential for the plants because it has several benefits like absorption of nutrients, increases drought resistance, enhance plant efficiency in absorbing water and nutrients from soil. Especially, AM fungi are very useful in the agriculture because it serves as biofertilizers as it helps in the absorption of phosphorus, and other nutrient uptake.