



Absorption of Mineral Salts by Higher Plant

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Let us make an in-depth study of the Mycorrhizae. After reading this article you will learn about their role in absorption of mineral salts by higher plant. The association of a fungus with root of a plant is called as mycorrhiza (plural, mycorrhizae). Mycorrhizae play very important and significant role in facilitating absorption of mineral salts by plant roots through them. In nature, more than 80% angiosperms (both dicots and monocots) including virtually all plant species of economic importance and almost all gymnosperms are known to form mycorrhizal associations.

However, mycorrhizae are rarely present in:

- (i) Aquatic plants,
- (ii) Plants belonging to the families Brassicaceae, Chenopodiaceae and Proteaceae,
- (iii) Hydroponically grown plants,
- (iv) Young rapidly growing crop plants and
- (v) Plants growing in flooded or very dry or saline soils or soils with very low or very high fertility.

vi. The relationship of mycorrhizae is symbiotic or of mutualism in which both partners are benefited. The fungus absorbs mineral salts from the soil and releases them into cells of host root. In return, the host root cells provide carbohydrates supply to the fungus.

ii. The mycorrhizal fungi extend the rhizosphere and also the nutrient depletion zone in the soil (Fig. 7.11). This greatly facilitates absorption of mineral elements especially those which are less soluble and relatively immobile in soil such as phosphorous.

Those parts of mycorrhizal fungi which are in direct contact with organic litter in the soil, may also hydrolyze complex organic compounds to release minerals which are subsequently absorbed by them.

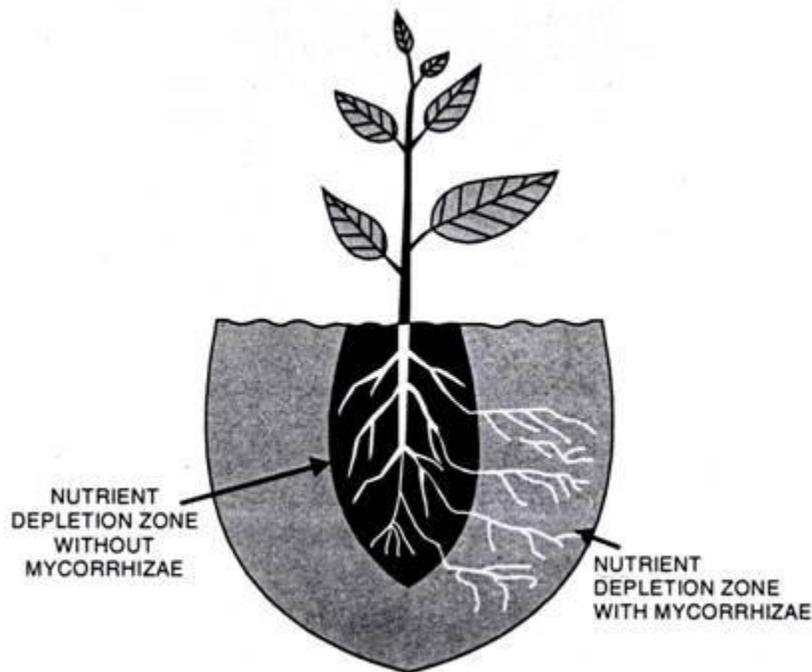


Fig. 7.11. Extension of nutrient depletion zone in the soil by mycorrhizae.

Numerous studies done with pines and other tree seedlings by scientists in U.S.A., Australia and other countries have shown an increase of 30-150% in dry weight of seedlings infected with mycorrhizal fungi as a result of increased absorption of mineral salts through mycorrhizae as compared to non-infected controls. Similar results have also been obtained with agricultural plants like maize.

The mycorrhizal fungi many of which are specific to host species may be grouped in two categories:

- (i) Ectotrophic mycorrhizae and
- (ii) Vesicular arbuscular mycorrhizae (VAM).

1. Ectotrophic Mycorrhizae:

These mycorrhizae form a thick mantle around the roots, part of which enters in between the cortical cells of the roots (without penetrating them) and forming an intercellular network of hyphae which is called as Hartig net (Fig. 7.12). Some of the hyphae from thick mantle around the roots extend into the soil reaching beyond nutrient depleted areas of the soil near the roots to tap fresh supply of mineral nutrients.

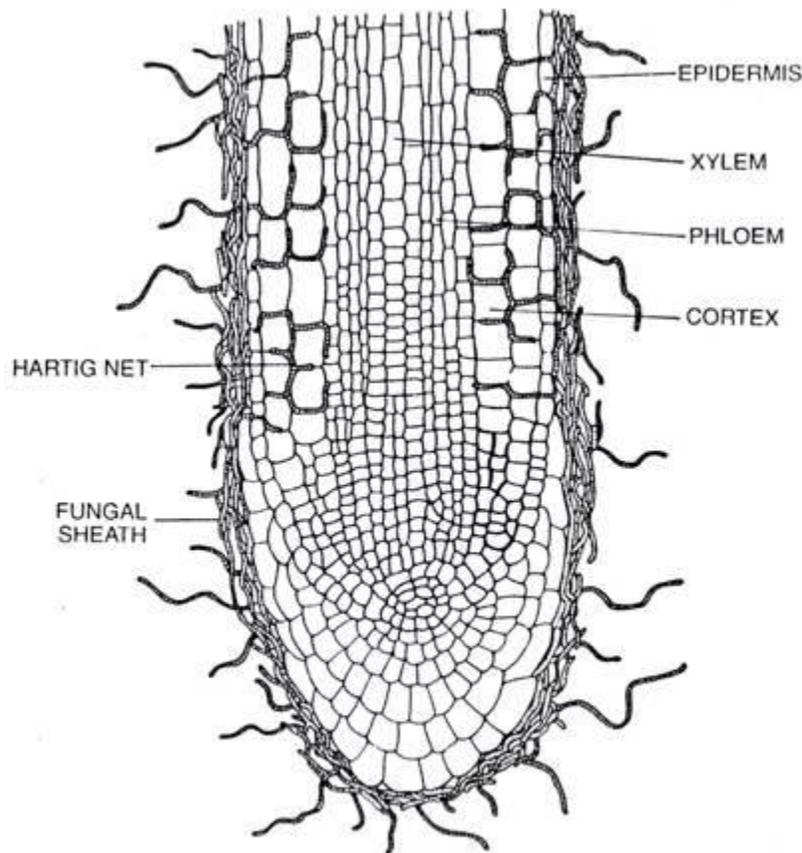


Fig. 7.12. Section of a root infected with ectotrophic mycorrhizal fungi.

The amount of ectotrophic fungal mycelium may be so considerable that its total weight may be comparable to the weight of host roots infected by it.

- i. Ectotrophic mycorrhizal fungi infect exclusively gymnosperms (such as pines) and woody angiosperms.
- ii. The mineral salts absorbed by ectotrophic mycorrhizal fungi directly diffuse into cortical cells of host roots through Hartig net.

2. Vesicular Arbuscular Mycorrhizae (VAM):

Vesicular arbuscular mycorrhizal fungi infect roots of most of the species of herbaceous angiosperms, but unlike ectotrophic mycorrhizae do not form a thick mantle around the roots. Their total weight also is far lesser (about 10%) as compared to weight of roots which they infect. The mycelium of VAM penetrates the host roots through root hairs and epidermal cells. The hyphae extend in between the cortical cells and also penetrate the latter where they form small ellipsoid oval structures called as vesicles and highly branched tree like structures called as arbuscles (Fig. 7.13).

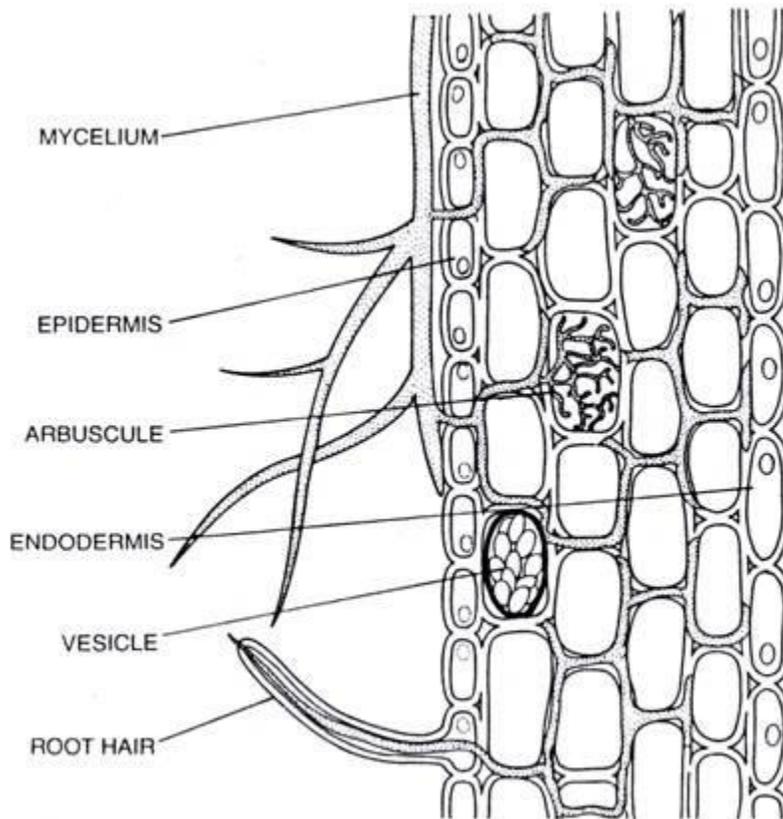


Fig. 7.13. Section of a plant root infected with vesicular-arbuscular mycorrhizae (VAM)

In arbuscles, the branches of fungal hyphae are surrounded by plasma membrane or tonoplast of host cortical cells. Therefore, the fungal hyphae actually penetrate only the cortical cell walls and not the protoplast. As a result of infection by VAM, the cytoplasmic volume of the cortical cells of host roots



may increase by 20-25%. The arbuscles serve to increase the contact surface area between hyphae and cortical cells for exchange of nutrients by 2-3 times. In VAM, the minerals may diffuse from arbuscles to cortical cells of host root either (i) directly or (ii) by releasing their contents into the latter when they disintegrate. As with ectotrophic mycorrhizae, in VAM also some of the finer hyphae from mycelium present around the roots extend into the soil beyond the nutrient depleted areas to tap fresh supply of minerals.