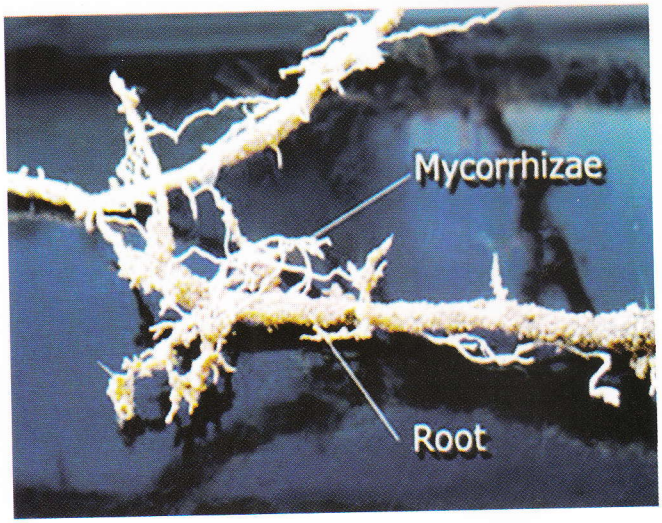
BIO FERTILIZERS FOR SUSTAINABLE FOOD PRODUCTION

Dr Rakesh Singh Sengar & Devendra Kumar

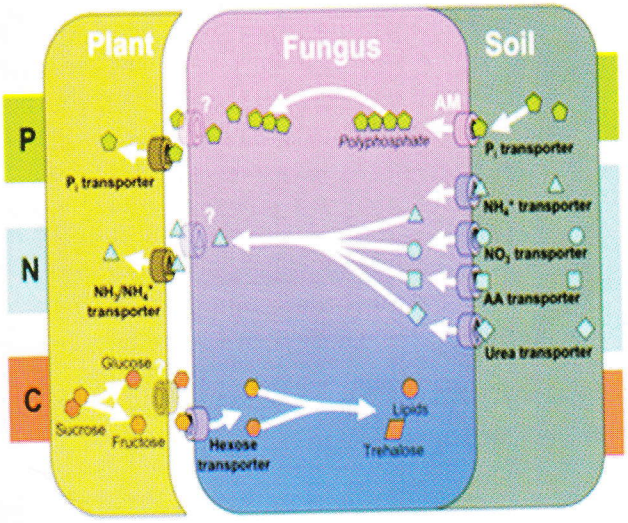
Mycorrhiza as biofertilizer form a network of filaments that associated with plant roots, increases the absorption of nutrients, particularly phosphorus and thus enhance the growth of crop plants and trees. Therefore, it is important in crop production and receiving considerable attention in agriculture. Currently, VAM (Vesicular Arbuscular Mycorrhiza) as biofertilizer is utilized in fumigated soils, greenhouse crops, and in the reclamation of disturbed sites. Ectomycorrhizae are employed in the establishment of trees in nurseries and in the production of containerized seedlings. They improve soil quality by binding particles together in addition to the provision of nutrients.

It has been observed that up to 90% of applied P-fertilizer(Phosphorus fertilizer) is rendered unavailable for crop uptake due to fixation. For P-fixation, mycorrhizal inoculation of plants is one of the alternatives. Fungi, which form symbiotic association with roots of plants are referred as mycorrhizal fungi and the association itself is referred to as "mycorrhizae". "Mycorrhiza" is made up of two words- mycor (fungus) and rhiza- (root) and literally means root fungus. These soil microorganisms i.e. the fungus are thought to be as old as our mother land and distributed all over the earth. Mycorrhiza form a network of filaments that associated with plant roots, increases the absorption of nutrients, particularly phosphorus and thus enhance the growth of crop plants and trees. Therefore, it is important in crop production and receiving considerable attention in agriculture.

Currently, VAM (Vesicular Arbuscular Mycorrhiza) as biofertilizer are utilized in fumigated soils, greenhouse crops, and in the reclamation of disturbed sites. Ectomycorrhizae are employed in the establishment of trees in nurseries and in the production of containerized seedlings. They improve soil quality by binding particles together in addition to the provision of nutrients. Various functions of the mycorrhiza (VAM), except Chenopodium, Brassica etc. as these are not infected by this fungus, are as follow;

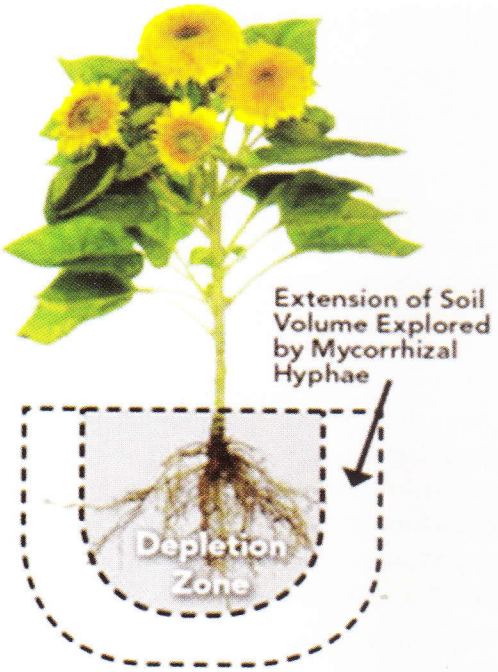


a) The main function of the mycorrhiza is to dissolve the fixed phosphate available as insoluble phosphate in the rhizosphere zone i.e. the zone in the soil surrounding the roots



and make it available to the plants through the hypha roots which are tube like structure that these fungi leave into the rhizosphere zone through which the dissolved phosphate reaches the roots.

b) Mycorrhiza also helps in the dissolution of trace elements which are in the form of insoluble compounds due to high alkalinity and make them available to the plants. The continuous use of urea over the years since mid sixties when green revolution started has caused the soil to become more alkaline and the trace elements already available in the soil



acquired the form of insoluble hydroxides/ other amines.

c) These fungi synthesize certain chemicals like HCN (Hydrogen Cyanide) etc. and release them in the rhizosphere zone, which protect the feeder roots of plants from the attack of various pathogens in the rhizosphere zone.

d) The mycorrhiza also helps during the nitrogen fixation because the phosphate requirement in the nitrogen fixation and water transport is fulfilled through mycorrhizal activity hence mycorrhiza can be used with Rhizobium.

Arbuscular Mycorrhizae (AM):

These are the most common mycorrhizae, first to evolve and members of the Glomeromycota, they are obligate biotrophs and associated with roots of about 80% of plant species, including many crop plants. The AM association is endotrophic, and has previously been referred to as vesicular-arbuscular mycorrhiza (VAM). AM persists as large spores of up to 400um diameter in soil and infect roots from germinating spores by forming an aspersorium like structure on the root surface. From this, the hyphae grow between the root cortical cells and penetrate individual root cells to form arbuscles, which are extremely finely branched tree like structures that occupy most of the cell volume. Arbuscles have a lifespan of 14 days. However the supply of mineral nutrient to the host is known to occur before the arbuscles are digested. The commercial inoculants are made from infected root fragments, hyphal fragments and spores, mainly of fungi in *Glomus* genus.

Ericoid endomycorrhizae:

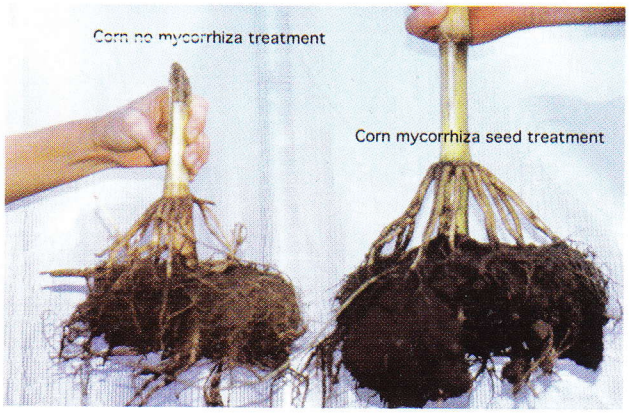
Fungi are members of the Ascomycota (*eg. Hymenoscyphus ericae*). The plant's rootlets arecoveredwithasparsenetworkofhyphae;thefungus digests polypeptides saprotrophically (extracellular digestion) and passes absorbed nitrogen to the plant host; in extremely harsh conditions the mycorrhiza may even provide the host with carbon sources (by metabolising polysaccharides and proteins for their carbon content). Two specialized subgroups may be separated out of the ericoid endomycorrhizal group- (i) Arbutoid endomycorrhizas, (ii) Monotropoid endomycorrhizas.

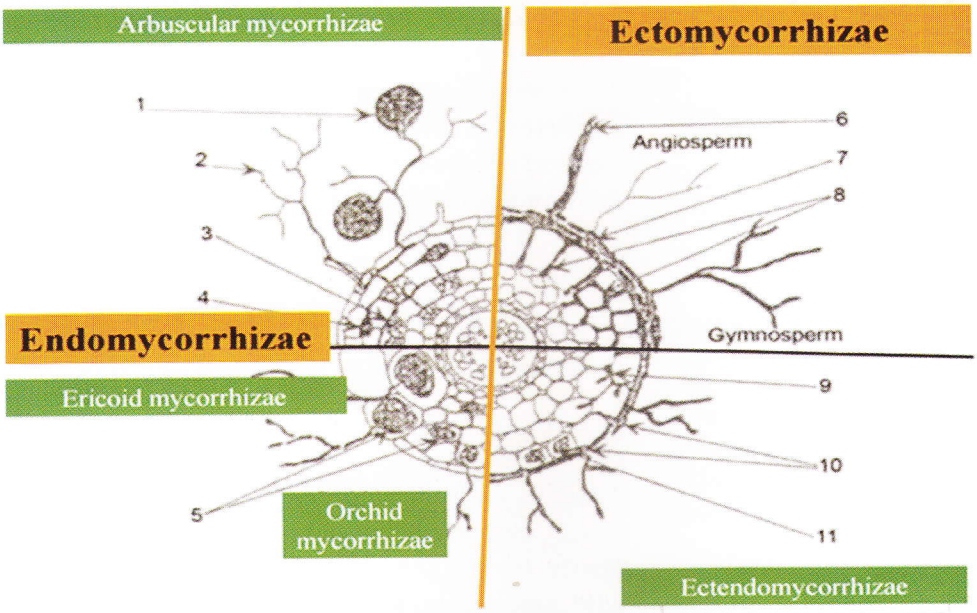
Orchidaceous endomycorrhizae:

Similar to ericoid mycorrhizae but their carbon nutrition is more dedicated to supporting the host plant as the young orchid. All orchids are achlorophyllous in the early seedling stages. A characteristic fungus example is the basidiomycete genus *Rhizoctonia* (a complex genus which can be divided into several new genera).

Ectomycorrhizae:

Ectomycorrhizal fungi are mainly Basidiomycota and include common woodland mushrooms, such as *Amanita* spp. most advanced symbiotic association between higher plants and fungi involving about 3% of seed plants including the majority of forest trees. In this association, the plant root system is completely surrounded





http://www.microbiologyprocedure.com/mycorrhizae/ectomycorrhizae.html

by a sheath of fungal tissue. The hyphae penetrate Hartignet.

Ectendomycorrhizae:

Ectendomycorrhizas have the same characteristics as ectomycorrhizas but show extensive intracellular penetration of the fungal hyphae into living cells of the host root.

Inoculation Methods:

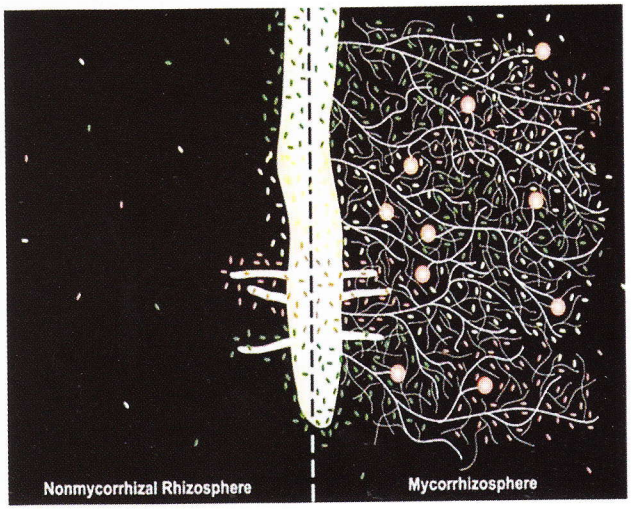
VAM inoculum is now commercially available in India. VAM is now available in 1 kg pack costing Rs. 100 under the trade name "Ecorrhiza" and "Josh" respectively. For one acre of the land, 4-5 kg of VAM inoculums is sufficient which can be mixed with 200 kg of powdered cow dung manure/ FYM/ soil and mixed in the fields uniformly while preparing the fields (Anon, 2006). The field can be ploughed two-three times so that it gets distributed in the soil. Inoculums may differ depending upon the number of plants per acre. When the number of plants per acre are more than 40,000, 5-10 kg of inoculum is required as the requirement of the plants increases with the increase of plants.

Inoculation of crops directly sown in the field:

Seed coating with AM inoculums: Coating with mycorrhizae inoculum is the easiest method of inoculating plants with AM fungi, if it provides consistently good infection. Seeds are coated with an adhesive e.g. methyl cellulose, to which inoculum is expected to stick and subsequently infect the emerging radicles.

Mycorrhizae pelletes: This method is technically more feasible to incorporate seeds in to inoculums to form multiseeded pellets rather than coating seeds with AM inoculums. These pellets about 1cm in diameter consists of soil inoculum from pot cultures, stabilized with clay or peat inoculums.

Inoculums in furrows: Placing inoculums under or beside seed sown in a furrow is probably an effective method of inoculating field sown crops.



Pre-croping: Population of AM propogules can be raised *in situ* by growing strongly mycorrhizal host plants and leaving the infected roots and associated spores in the soil to infect the next crop.

Fluid drilling: Incorporations of seeds and inoculums in a uniform suspension are another means of placing seeds and inoculum in proximity.

Inoculation in transplanted crops:

Seedlings may be dipped into the water suspension of the inoculum containing some jaggery or molasses before transplantation. Alternatively, the seed beds may be inoculated with VAM while raising the nursery.

This method includes putting 2 g of the inoculum in the micropits to a depth of 3-4" below the soil level while transferring the seedlings in the fields. Even if the seedlings have been stabilized after the transplantation, the inoculums with VAM can still be carried out by making 5" deep holes with a hollow pipe (1-2" diameter) 1-2" away from stems of the plants and putting 2 g of VAM inoculum in these holes and then filling the holes with soil.

Seedlings are raised in sterilized or unsterilized soil supplied with selected AM fungi in small nursery beds and planted out when mycorrhizae colonization is well established. This method has been successfully used to produce in agronomically important crops like citrus, mango, asters, and marigold and forest tree species like *Leucaina, Casuarina equisetifolia. Tamarindus indica,* and *Acacia nilotica.*

Conclusion:

Mycorrhiza, a potential biofertilizer is considered as a boon for agriculture because it provides phosphate, other trace elements to the plants by forming a symbiotic association with plants. By the use of nitrogen fixing biofertilizers with mycorrhiza, PSB and organic manure, it will increase the C:N (Carbon to Nitrogen ratio) and ultimately, leading to increased production.

(Dr Rakesh Singh Sengar is Professor & Head, Department of Agricultural Biotechnology Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, UP. Email: sengar065@gmail.com)

Women of India Organic Festival 2018

The 5th edition of the 10-day 'Women of India National Organic Festival 2018' was inaugurated on 26th October 2018, at IGNCA, Janpath Road by the Union Minister of Women and Child Development, Smt. Maneka Sanjay Gandhi, Over the 10 days, women farmers and entrepreneurs from across the country, participated with vast variety of organic products ranging from food and fabrics to wellness and personal care participated in this festival, is an annual affair and serves as a platform to celebrate and promote women farmers and entrepreneurs from different corners of India.

This year, the total sales by the women farmers and entrepreneurs who came from 26 States, were a record of over Rs. 2.75 crore, up from Rs. 1.84 crore in last year's edition that was organised at Dilli Haat, INA, New Delhi. The festival is had footfall of nearly 12 lakh. The success of the Organic Festival has added to the joy of the women farmers from diverse as well as far off corners of the country, such as Majuli, Kangra, Leh, Palakkad, Chikkmaglur, Yavatmal, Dimapur and Almora, among others. Participants had the opportunity to travel and stay in Delhi free of cost for the entire duration of the Festival while enjoying the experience of selling their wholesome goods to Delhiites, who thronged the lawns of IGNCA, not only on weekends, but also on weekdays. This year saw the grand debut of the Food Court and Vegan Food, which were very well received by all visitors.

The participants of Women of India National Organic Festival 2018 also had the opportunity to enroll themselves in Mahila-E-Haat, which is an online marketing portal set up by the Ministry of Women & Child Development, to meet the aspirations and needs of women entrepreneurs.