

Mycorrhiza (VAM)

Biofertilizer for the future

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The endomycorrhizae (Vesicular Arbuscular Mycorrhizae, known as Arbuscular Mycorrhizae, VAM) plays significant important role on enhancing the plant growth and yield due to an increase supply of phosphorus (P) to the host plant. Mycorrhizal plants can absorb and accumulate several times more phosphate from the soil or solution than non-mycorrhizal plant. Plants inoculated with endomycorrhizae showed to be more resistant to some root diseases. VAM fungi are symbionts with terrestrial plants roots. It is now generally recognized that they improve not only the phosphorus nutrition but also its growth which may result in an increase in resistance to drought stress and some disease. Therefore, VAM fungi offers a great potential for sustainable agriculture and the application of VAM fungi to agriculture was developed.

Key words: Biofertilizers, Mycorrhiza



Fig. 1. Mycorrhiza (fungus-root) refers to a mutualistic, symbiotic relationship formed between fungi and living roots of higher plants.



Fig. 2. Comparison between control and after supply of Vesicular Arbuscular mycorrhizae

MYCORRHIZAL mycelia are species of fungi that intimately associate with plant roots forming a symbiotic relationship with the plant providing sugars for the fungi and the fungi providing nutrients such as phosphorus to the plants. Mycorrhizal fungi can absorb and transport large quantities of phosphate within their hyphae and release to plant cells in root tissue.

Initially, the mycorrhizal biofertilizer production is for economic crops like papaya, tamarind,

mangosteen etc. Now the biofertilizer can be used for vegetables (used in vegetable nursery mixture) and rubber. Mycorrhizae are associated plants either upon root surface (ectomycorrhizae) or inside root tissue (endomycorrhizae). The VAM (expand) fungi are a common member of endomycorrhizae.

Significance of VAM fungi

The use of mycorrhizal fungi as a biofertilizer in crop production which is an expensive and eco-friendly input, is capable of enhancing both P

availability and water-use efficiency of crops and might have proved very effective strategy in mitigating various stresses. Besides P, VAM fungi also supply other plant nutrients such as nitrogen (N), potassium (K), calcium (Ca), copper (Cu), zinc (Zn) etc. to the plants, which are absorbed by VAM from soil leading to increased input economy in fertilizer P following VAM inoculation moreover, it enhances water-use efficiency by about 15 to 30%. Above fungi not only meet out nutrient and water



Fig. 3. Mycelial hyphae

requirement of crops but also confer other associated benefits on plants such as increased resistance to diseases, drought soil salinity and also enhance N_2 -fixation in legumes.

Benefits of mycorrhizal fertilizer

- Mycorrhizal plant can absorb and accumulate many-fold more phosphate from the soil or solution.
- Mycorrhiza increase root surface area for water and nutrients uptake.
- It helps to improve higher branching of plant roots.
- VAM allow plants to take up nutrients in unavailable forms or nutrient that are fixed to the soil.
- It enhances plant growth, improves crop yield and increase income for the farmers.
- It leads to improvement in plant photosynthesis nutrient translocation and plant metabolism processes; therefore, the plant has better growth and yield, reduce the use of chemical fertilizer.
- Improve plant resistance to root rot and collar rot disease.
- It leads to improvement in soil structure by way of binding of soil aggregates, involving their hyphal network and in turn enhancing soil moisture retention capacity.
- It was found that the crop yield improved by more than 50% and the farmers' income increased 61% higher than when chemical fertilizer alone was used.
- It can be used together with other agricultural chemical.
- Mycorrhiza are endurable to several chemical substances; for example: pesticide i.e. endrin chlordane, methyl parathion n, methomyl carbofuran; herbicide i.e. glyphosate, fluazifopbutyl; chemical agents for plant disease elimination such as captan benomyl maneb triforine mancozeb and zineb.
- Further, continuous and long-term

application of VAM fungi substantial increase organic matter status in soil by way of addition of extra roots. i.e. mycorrhiza roots as well as improved plant roots biomass due to extra nutrient availability for root growth.

Findings and suggestions regarding the application of VAM

Plant growth in low fertile or acid soil: The beneficial effect of VAM used in biofertilizers to plant especially low fertility are well documented, in acid soil it increase the phosphorus (P) -uptake and also N-uptake and crop yield due to mycorrhizal association.

In mycorrhiza laboratory of Chittagong University studied the influence of mycorrhizal association in growth improvement of a large number of agricultural and horticultural crops, ornamental plant, forest plant, tea, rubber and other plantation species.

Transfer of carbon and nutrients: VAM play an important role in the direct transfer of carbon from one plant to another. The plant roots are inter-connected by mycorrhizal hyphae through which the nutrients move from one plant to another. VAM can mediate interplant transfer of P and N, when there are legumes and non-legume growing in N deficient soil, this flow of N will likely be from legume to non-legume and may be of considerable significance to the N-economy of the non-legume. The interplant nutrient transfer technology may be useful for Bangladesh agriculture.

The implementation of *Rhizobium* technology available in our country needs mycorrhizal fungi for P nutrition, which is needed as energy of *Rhizobium* bacterial for better fixation of N from atmosphere.

Tolerance against attack of root pathogens: Several studies showed the potential of using VAM for establishment and growth of different micro-propagated species after transplanted. The VAM appear to decrease plant susceptible to disease or increase tolerance against the attack of root pathogens. The research showed that VAM increase plant tolerance to salinity thereby



Fig. 4. Internal study of VA mycelial

increasing yield in saline soils. The VAM can help plant to become established in nutrient deficient soils or degraded habits and can assist plant establishment in coal waste eroded desert and disturbed soil.

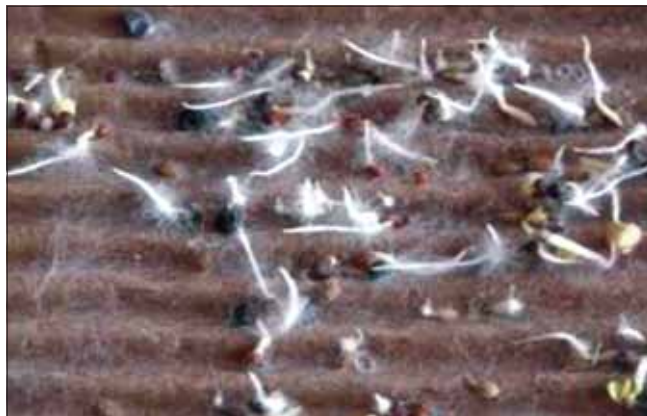
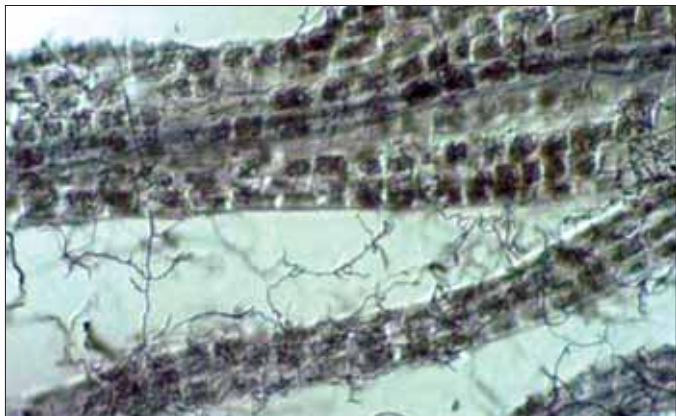
Land-rehabilitation and fertility: Land-rehabilitation induced the mediation of soil aggregation – a process known to be carried out by VAM fungi which can improve plant–water relations in many situation, the VAM fungi can helps cope with drought stress. It plays a significant role in the regulation of soil-biological activities because of their abundance throughout the upper most soil layer. It is interacting with other beneficial soil microbes to improve the soil fertility where soil biological activities are reduced because of burning and shifting cultivation.

In last one- and -half decade showed mycorrhizal studies that mycorrhizal inoculation enhances plant growth in problematic soil.

Reduce the arsenic contamination in crop: More than 300 million people are already facing the problem of arsenic contamination in our country. Arsenic poisoning causes skin pigmentation development of warts, ulcer cancer etc. To reduce the arsenic contamination in crop plant a number of experiments conducted under USDA, ICAR financed project indicated that using mycorrhizal fungi could reduce arsenic in crops. For instance *Pteris vitata*.

SUMMARY

Based on above information, it is summarised that inoculation of plants with VAM fungi, improved nutrient and water absorption, enhances input use efficiency, crop quality and overall soil quality and led to nutrient economy. VAM fungi also confer other associated benefits on plants.



Such as increased resistance to disease, drought, soil salinity and also enhance N-fixation in legumes as such, proves magical fungi in soil plant system and it is said that there is a biofertilizer which may be useful for future. The mycorrhizae fungi carry out its functions by expanding surface area of plant root system by 10- to 1,000-folds into the soil through their ramifying hyphae,

thereby increasing their exploratory area for harnessing phosphorus others nutrient and water. Further, VAM fungi solubilize inorganic forms of nutrients through release of low molecular weight organic acids (oxalic malic acid etc.) Further, through secretion of a number of enzymes (chitinase, peroxidase, cellulose, protease, phosphatase etc.) VAM fungi attack on complex

organic compounds converting them into simple ones that can be absorbed and used by fungi/host plants to meet their energy needs for growth and reproduction.

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Attracting and Retaining Youth in Agriculture (ARYA)

Realizing the importance of rural youth in agricultural development especially from the point of view of food security of the country, ICAR has initiated a program on "Attracting and Retaining Youth in Agriculture.

The objectives of ARYA project are:

- (i) To attract and empower the youth in rural areas to take various agriculture, allied and service sector enterprises for sustainable income and gainful employment in selected district;
- (ii) To enable the farm youth to establish net work groups to take up resource and capital intensive activities like processing, value addition and marketing; and
- (iii) To demonstrate functional linkage with different institutions and stakeholders for convergence of opportunities available under various schemes/program for sustainable of youth.

ARYA project will be implemented in 25 states through KVKs, one district, 200-300 rural youth will be identified for their skill development in entrepreneurial activities and establishment of related micro-enterprise units in the area of Apiary, Mushroom, Seed processing, Soil testing, Poultry, Dairy, Goatry, Carp-hatchery, Vermi-compost etc. KVKs will involve the Agricultural Universities and ICAR Institutes as technology partners. At KVKs also one or two enterprise units will be established so that they serve as entrepreneurial training units for farmers. The purpose is to establish economic models for youth in the villages so that youths get attracted in agriculture and overall rural situation is improved.

The trained youth groups will function as role model for other youths and will demonstrate the potentiality of the agri-based enterprises which will help in improving their confidence levels and encourage them to pursue farming as profession, generate additional employment opportunities to absorb under employed and unemployed rural in secondary agriculture and service related activities in rural areas.

Pradhan Mantri Krishi Sinchai Yojana

This Yojana brings

- Per Drop More Crop.
- Inputs from MoWR and DOLR received.
- Increase in agricultural production and productivity and enhance farm income.