VA-MYCORRHIZAL STUDIES IN SOME ECONOMICALLY IMPORTANT TIMBER TREE SPECIES

SUMMARY

VA-Mycorrhizal or 'fungus roots' involve the intimate association of plant roots with specialized soil fungi. Forest tree seedling lacking mycorrhizae can be severely stunted and their growth in new locations the form of NPK. The mycorrhizal fungi absorb nutrients from soil to the mycorrhizal fungi. The mycorrhizal mycelia thus serve as highly efficient extensions of the roots systems. Providing the synthetic fertilizers for these plants cost wise becomes uneconomical and not feasible. Under these circumstances the alternative and economical source is to provide the nutrients by manipulating the beneficial microbes along with VAM.

Foreseeing the magnitude of importance in the afforesatation programs VAM studies in some economically important timber tree species has been done.
The species selected for VAM study are

1) *A. heterophyllus*  2) *E. bracteata*  3) *L. lanceolata*
4) *P. marsupium*  5) *T. tomentosa*  6) *T. bellirica*. The structure, morphology, anatomy and histological study in depth regarding the VAM associated with six experimental plants have been made. The microtechnique described by Johansen and root clearing and staining method envisaged by Phillips & Nicolson was adopted. Scanning electron microscopic studies has also made in *A. heterophyllus, E. bracteata T. tomentosa T. bellirica* wherein there was profuse colonization and fungal components. Quantification of colonization has been made using the Grid Line intersect method. The percentage of colonization estimated was more than 80% in the experimental plants. The studies revealed the different phases and components of endophyte has been observed. The extramatrical hyphase extended nearly 1 cm away from the root surface. The resting spores has been found outside the root surface. The infection points with appressorial hyphal structures has been observed on the root surface. The young hyphae is rich in cytoplasm where as the older hyphae had thick walls. The hyphae has been found growing in different directions of the cortical region. Hyphae did not spread beyond endodermis. Hyphal size and nature varied on its entry into
intercellular space in the cortical region. Arbuscule look like branched 'little trees' with finger like processes. Arbuscules exhibited various stages of its growth as well as disintegration. The arbuscules are found to be in close contact with the cytoplasm of the host cell. Vesicles globose to oval shaped ones are found at the terminal ends of intercellular hyphae. Some vesicles are found big in size, and others in groups and in chains. The dense granular cytoplasm with full of fat globules are being observed in the matured vesicles. Colonization of the endophyte in all the experimental plants have been observed. The colonization started from second set of lateral roots from the top. But the colonization of the fungus has not been observed near the tip or mertistematic zone of the root. No morphological change in the root system was observed.

First time an extensive survey work on the VAM spore distribution, population dynamics, associated with rhizospheric soils of six experimental plants growing in the South Western part of India in Karnataka has been done. The survey area comprised of 76 locations extending from longitude 74°0' to 75-25' and 11°35' to 17°00' latitude of South Western peninsular India stretching 650 km in length and 250 km width. Spores were recovered from the rhizospheric soils of different locations.
following the techniques envisaged by Gerdemann & Nicolson and floatation and adhesion technique described by Sutton & Barron. Smallest spores were also recovered from the soil. Genera wise enumeration of spores from ten selected forest locations have been done. Influence of season on the spore population has been done. Influence of seasons on the spore population has been done. The spores recovered are represented in five genera namely Acaulospora, Gigaspora, Glomus Sclerocystis and Scutellispora. The spore numbers in evergreen forests (493-804/100g soil), 43-970/100g in scrub jungle, 716-1294/mg in moist deciduous forests, 674-1417/100 g and dry deciduous 794/1502/100 g of rhizospheric soils of the experimental plants. Where as least number is recorded in marshy lands (27-201/100g). About 45 species of spores are found to be new reports from this geographical area. Sclerocystis species were not in sufficient number in number of locations compared to other genera. Spore numbers were more in soil depths from 5 to 10 cms. There is an increase in spore number during spring and autumn than summer and winter season. G.mosseae were found in all the rhizospheric soils of the experimental plants, as such it was selected for other experiments as inoculum.
The effect of *G. mosseae* (Nicol. & Gerd.) on growth and biomass production of six timber tree species were conducted. *G. mosseae* was multiplied on the host *pennisetum typhoideum* in pot cultures to obtain good quantity of inoculum. The inoculated mycorrhizal plants exhibited good biomass production in respect to height, shoot fresh and dry weight, nodal length, leaves etc., over the control non mycorrhizal plants. Percent colonization and number of spores 893/100 g soil is quite significant. All the mycorrhizal experimental plants showed higher P content in their shoot over the controls in all the stages of harvests (0.23% to 46%). Mycorrhizal *T. tomentosa* showed highest 0.46% P content. The results form this study indicates the benefit accrued by VAM inoculation and favour the introduction of VAM as cultural practice in nursery.

The most consistent host response to VAM infection occur as a result of improved P nutrition. The effect of phosphate fertilization and uptake on growth of six experimental plants inoculated with *G. mosseae* (Nicol. & Gerd.) has been studied. The phosphate sources selected was super phosphate and rock phosphate. The effect of P fertilization on all the experimental plants exhibited varied responses. Even the low dose application of 'P' was effectively utilized by mycorrhizal plants. Phosphorus
concentrations of tissue differed in certain cases depending upon the levels of available P. Rock phosphate fund to be best along with VAM as it releases the phosphorus slowly which could be effectively taken and translocated to the host by extramatrical hyphae of the endophyte.

The obligate nature of VA mycorrhizal fungi and their anatomical morphological and physiological processes of the host endophyte relationships have been examined with histological and histochemical techniques. The products of physiology and metabolism of the mycorrhizal host and the chemical substances, enzymes have been localized in the different components of endophytic fungi. The chemicals localized in vesicles and arbuscules are polyphosphates. The enzymes such as cytochrome oxidase, peroxidase, succinic dehydrogenase, and acid phosphates. Starch grains were localized in the host cells and not in arbuscules indicate the entry of this carbohydrates into arbuscules in different soluble form. Localization of polyphosphate are translocated form endophyte to the host cells through arbuscules after enzymatic reaction.

The rhizospheric biology of the leguminous tree species namely *p. marsupium* has been conducted to study the interaction between VAM and other beneficial microorganisms and their effect
on growth. The microorganisms such as *Rhizobium leguminosarum*, *Bacillus circulans* (PSB), *Azospirillum brasilensis* along with *G. mosseae* in different treatments were used in the study. The treatment of *G. mosseae*+*Rhizobium* recorded significant growth and P content compared to non mycorrhizal plants. But when all the microbes combination treatments recorded significant effect representing synergistic and cumulative effect. This can be taken for the package of practices in the nursery management.

Ecological importance of vesicular arbuscular mycorrhizal fungi have been studied with reference to the six experimental plants as a plant community, which grow in evergreen, semi evergreen dry deciduous regions of the South Western part of peninsula. The study confined in relation to effect of litter and litter decomposed soils, effect of different soil pH values on VAM associated plants, and spread of VAM in the soil from plant to plant in plant community.

The experimental plants grown in different combinations of litter and soil exhibited varied responses. Soil and litter combination in the proportion of 1:1, 10:0.75, 1:0.50 & 1:0.25 were used with and without inoculum. From the observation it is found that the litter soil proportion 1:0.25 is favorable for the growth, biomass production % colonization as well as % P uptake.
The natural soils having different pH values from 4.5 to 10.5 was selected for the experiments. The seedlings grown with and without inoculum in these soils exhibited varied responses. It is found that the plants growing at soil pH 6.5 to 7.5 is optimum for both host and endophyte.

Experiments were conducted simulating the natural soil ecological conditions to study the extent of colonization through transversing and spread of VAM inoculum provided at one point to six experimental plants raised in a row. In one set of experiment the inoculum are placed at one end traversed through the soil and infected the plant and subsequently from plant to plant in the row. In another set of experiment the inoculum placed in the center infected the rest of the plants positioned equidistantly. This suggests that in a plant community the roots overlap and intertwined with each other, come in contact with VAM and get colonized. There is all possibility VAM infection may take up from one another. The mycelia was found to traverse a distance of 10cms from the place of inoculum.

In the light of the understanding and the knowledge gained certain recommendations have been proposed in the form of package practice for skillful production of resilient planting stock.
The integrated use of mycorrhizal management tools with other cultural practices and the potential use of selected beneficial fungi for mycorrhizal inoculation of seedlings will help to ensure the successful production of vigorous planting stock.