VA-MYCORRHIZAL STUDIES IN SOME ECONOMICALLY IMPORTANT TIMBER TREE SPECIES.

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Vesicular-arbuscular mycorrhizas (VAM) are roots infected with particular soil fungi which form symbiotic associations. VA-mycorrhizae have always been integral components of forest ecosystems with mutual dependency between fungus and host for natural function and survival. The mycorrhizal fungi absorb nutrients from soil and translocate them to host plant. The host provides photosynthates to the mycorrhizal fungi. The mycorrhizal mycelia thus serves as highly efficient extensions of the root systems. Mycorrhizae are an important consideration in maximizing range productivity, because mycorrhizae dependent plants cannot succeed without their fungal associate. Mycorrhizal fungi grow between or into cortical cells of root lets and out into the surrounding soil. Within the root cortex nutrients absorbed by the fungus from the soil and translocated to the host and photosynthates and their derivatives are extracted from host tissue by the fungus. The fungal hyphae extending into the soil serve as extensions of the root systems, extensions that are both physiologically and geometrically more effective for nutrient absorption than the roots themselves.
The importance of mycorrhizae to forest establishment has been most graphically demonstrated in afforestation programmes. National and global afforestation policy has laid down an ambitious programme to bring the waste lands, arid lands, saline soil, eroded soil, soils of mined area under green cover.

Present biomass production in the state is of the order of 0.28 million tons/year from known sources, which includes timber, fuel wood, fodder and other plants. Biomass requirement at the end of the century will be of high magnitude, hence there will be tremendous need for huge quantity of biomass productivity to improve the environment and subsistence to wild life.

In this direction department of forests, National and Government of Karnataka has programmes of afforestation in eroded soils, waste lands, mined areas, hillocks, disturbed soils and adverse sites. These areas are naturally deplinished with nutrients.

Under the afforestation programme saplings are raised in nurseries and during the monsoon season, these are transplanted in different locations. These young saplings have to establish itself in an hostile environment. The establishment of saplings in the newer areas form the successful phase in forest development. Some saplings do not establish properly in the new locations after transplantation, for want of proper nutrients.
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 such as nitrogen fixing bacteria, phosphate solubilizing bacteria and VAM for absorption of NPK and other micronutrients from the soil.

In view of this problem of new dimension to facilitate the acclimatization of the saplings, study of mycorrhizal association have to be considered. Our survey work on the mycorrhizal association in timber trees has revealed interesting phenomenon. Plants lacking mycorrhizae have stunted and poor growth and mortality rate increases. Mycorrhizal deficiency has been a recurring problem in forest nursery practices. Saplings with vigorous mycorrhizal roots will have a competitive advantage over saplings with poor non-mycorrhizal. A root system strongly mycorrhizal with proven efficiency for inoculation of saplings will help to ensure the successful production of vigorous planting stock.

Investigations on mycorrhizae in recent years have gained an amplitude justified by the importance of the problem. Many excellent books and reviews on mycorrhizae have been published. Among those of greatest interest are Boullard (1968); Harley (1969); Hacskaylo (1971); Marks and Kozolowski (1973);
Mosse (1973); Meyer (1974); Smith (1974); Mikola (1980); Sanders et al. (1975); Gerdemann (1975); Hayman (1978); Marks and Krupa (1978).

Foreseeing the conditions we have selected six timber yielding tree species, which grow in forests of this geographical area. It is of economic importance for its timber and other useful properties. These plants are also raised in forest nurseries for afforestation programmes.

So far in depth study of the VAM associated tree species has not been conducted from this geographical area. In the light of the above said facts a study and detailed understanding of VAM association prevailing in the plants is undertaken. The findings of research will be useful in formulating a nursery package practice for the success of the afforestation programme. As a result of research of forest trees, a new technology that attempts to use mycorrhizal fungi for the benefit of man can emerge. With this view, the following aspects are considered as aims and objectives of investigation to obtain useful information of applicational value.

Tree species selected for VAM study:— (Plate: 1 Fig. 1-6, Table -1).

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Family</th>
<th>Geographical distribution</th>
<th>Height (mts)</th>
<th>Girth (mts)</th>
<th>Economic importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>Artocarpus heterophyllus</em> lam.</td>
<td>Moraceae</td>
<td>moist, ever green forest, cultivated in gardens.</td>
<td>20-25</td>
<td>2-3</td>
<td>Fruits edible, seeds used as vegetable, leaves fodder for cattle, wood used for furniture, building, manufacture of musical instruments.</td>
</tr>
<tr>
<td>2. <em>Eugenia bracteata</em> (Willd) Roxb.</td>
<td>Myrtaceae</td>
<td>deciduous, open forests, 35-40</td>
<td>3-4</td>
<td></td>
<td>Fruits used in diabetes treatment. Leaf juice for dehydration, wood used as building material and manufacture of boats, carts</td>
</tr>
<tr>
<td>4. <em>Pterocarpus marsupium</em> Roxb. (Fabaceae) * S.F. Fabiodae</td>
<td>Leguminosae</td>
<td>moist, mixed deciduous forests and marshy land.</td>
<td>40-50</td>
<td>2-3.5</td>
<td>Gum extracted from pods and used for wood polish etc., wood used for house materials and furniture.</td>
</tr>
<tr>
<td>6. <em>Terminalia bellirica</em> (Geotner) Roxb.</td>
<td>Combretaceae</td>
<td>moist, deciduous and dry</td>
<td>25-35</td>
<td>2-4</td>
<td>Bark used medicinally leaves as for cattle, goats and sheep etc., wood used for railway carriages, sleepers and building materials</td>
</tr>
</tbody>
</table>

* S.F. = Sub - Family.
1. *Atrocarpus heterophyllus* Lam.

OBJECTIVES

The present investigation was carried out to gain knowledge, aiming at the following objectives:

a. To study structure, anatomy, morphology including ultrastructure quantification of colonization of VAM association in six timber tree species. This type of study has not been done in this geographical area.

b. Studies on VAM spore types, distribution, population dynamics in the rhizospheric soils of experimental plants at different locations of South Western part of the Southern peninsular part in Karnataka State. This type of extensive survey work has not been carried out so far.
c. Histological and Histochemical studies to understand the symbiotic association as well as the localization of chemicals connected to its physiology and metabolism.

d. Selection and inoculation of an efficient native strain of VAM to study the effect on growth and biomass formation of six timber tree species.

e. Physiological studies connected to P uptake and other major and minor micronutrients in VAM associated plants and their growth and biomass production.

f. Interaction studies between selected VAM inoculum and other beneficial soil micro-organisms in the growth response of leguminous tree species.

g. Ecological studies of VAM associated tree species related to organic matter (leaf litter), soil pH and spread of the inoculum in natural plant community.

h. In the light of the studies, results obtained and inferences drawn leading to formulation of certain recommendations for package of practices for forest nursery management.