PLATE – 1

1. *Jatropha gossifolia* L.
2. *Jatropha curcas* L.
3. *Jatropha curcas* L.
VA-MYCORRHIZAL STUDY ON SOME HYDROCARBON YIELDING PLANTS
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Introduction

The intrinsic interest in the study of vesicular-arbuscular mycorrhiza fungi has been increased since three decades due to their beneficial role in the growth of the plants. This fungi is an integral component of majority of the plants in wide ecological range, with mutual dependency between fungus and host for natural function and survival. The fungus takes carbohydrates from the host plant and in turn supplies the nutrients. It is a well established fact that the VA-mycorrhiza in improve plant growth by improved uptake of nutrients especially phosphorus and other micro-nutrients. The ability of these fungi to produced dramatic response in plant growth is well documented. However, the application of this technology for commercial production of food, fibre and specifically for biofuel has been minimal. VA-mycorrhiza increased plant nutrient supply by extending the volume of soil accessible to plants. Besides, direct nutritional advantages the mycorrhizae also been accredited with other benefits to the host plants, such as increasing disease resistance, draught resistance etc. VAM fungi are able to bind soil in to semi-stable aggregates, thus improving the structure of the soil. A healthy plant soil system is the backbone of
sustainable farming without which sustainable development can never reach its maxima. Enhancing this viewpoint, organic farming has been offered as an alternate practice. Using only chemical fertilizers to enhance soil productivity does not seem to be a viable proposition. Thus, an eco-friendly alternative mycorrhizal fungi can partially replace chemical fertilizers and can help plants to establish on nutrient deficiency in disturbed areas.

A major constraint in increasing plant yields in the supply of nutrients among which nitrogen, phosphorus and potassium plays a key role. Considering the increased requirements of hydrocarbon and oil from the petroplants for the building world population. The prices of fertilizer in developing countries are clearly prohibitive harvest hit are the small and marginal farmers. There is a serious concern for adopting more sustainable environment friendly and low cost farming practices. Economic feasibility of using "Biofertilizers" carrier-based formulation of live and beneficial micro-organisms like VAM as a self generating source of nitrogen has been proved beyond doubt.

In a number of developing countries the substitution of imported petroleum derivatives by domestically produced biomass-based engine fuels is currently regarded as a promising strategy for eliminating energy shortages. Keeping with this in mind, the present study evaluates that using vesicular-arbuscular mycorrhizal fungi for the production of liquid
biofuels in the potential hydrocarbon yielding plants and utilizing them as a substitute for petroleum derivatives. The main advantage of these petrocrops cultivation is that the latex and resin bearing wild crops grow well with a minimum requirement of water and without much agricultural management. We are so much used to petrol and diesel as transport fuel that we think of converting any renewable source of energy into these fuels. Of course, petroleum fuels are the most convenient for the working of internal combustion engine. Therefore, it would be highly desirable if we can produce petrol-like hydrocarbons from plants. Considerable work has been done on the cultivation of petroleum plantations. The scientists of the Indian Institute of Petroleum (IIP), Dehra Dun, started working on the developments of energy crops for liquid fuels in 1979 in collaboration with the National sponsorship of the Department of Science and Technology (DST) and there are a large number of plants that produce hydrocarbons. The Department of Non-Conventional Energy Sources, studied after screening about 480 latex-producing indigenous plants and 74 resinous plants, and 54 common widely spread and easily cultivable plants were chosen for further studies. Research on hydrocarbon yielding plants has revealed its immense potential.

Tao (1970), an associate professor of agricultural and biological engineering at Purdue University predicts that over the next several
decades, plant oil will become just as essential to everyday life as fossil fuels are today. Tao says it may be possible to create a petroleum substitute. Fossil fuels were plants once millions of years ago, and so it makes sense that both the fossil fuels we use today and oils produced by plants are chemically similar. But, both are made up of chains of chemicals known as hydrocarbons. As hydrocarbons are simple molecules made up of carbon and hydrogen atoms joined together in chains petrol plants contain 14 to 18 carbons in length but Diesel fuel is 15 carbons long which is close the same size as plant oils. That is why the first applications are as biodiesel fuel.

Many hydrocarbon yielding plants are being considered these days as potential petro crops yielding biocrude which after various degrees of processing and blending with other fuels can be used for powering internal combustion engines (Hall et al., 1982; Datta and Mukharjee, 1986). These species can be commercially exploited if the biomass yields are increased by selecting suitable strains and better managements of agricultural practices. Association of Vesicular-arbuscular mycorrhizal fungi often improves biomass yield (Gerdemann, 1968 Lambart et al., 1979 Mao wad, 1986) by significantly increasing uptake of moisture and other elements. In order to undertake research experiments on productivity of these hydrocarbon yielding plants and on
the effect of VAM fungi on its growth and biomass was considered. Survey of the literature revealed that there has been no systematic study on the association of VAM fungi on hydrocarbon rich plants. In view of this problem of new dimension to facilitate acclimatization of the saplings. A study of mycorrhizal association has been considered. Survey work on the mycorrhizal association in hydrocarbon yielding plants has revealed interesting phenomenon.

Though some literature is available on the application of VAM fungi as biofertilizers on edible oil seeds, there is meagre or no information available on commercial hydrocarbon bearing plants. Therefore, in the present study two important potential hydrocarbon bearing plants *Jatropha curcas* L. *Jatropha gossifolia* L and three normal hydrocarbon bearing plants *Madhuca indica* Gmel *Ricinus Communis* L. (Var Mysore local) *Ricinus communis* L. (Var Rosa) have been selected (Plate-1 and Table-1).
The investigation was carried out with the following objectives.

- Morphology and quantification of VA-mycorrhiza in experimental plants.
- Spore distribution and population dynamics.
- Selection of efficient indigenous VAM spores for mass inoculum production.
- Effect of VAM on growth response in experimental plants
- Physiology of nutrients uptake and phosphate fertilization in experimental plants.
- Histochemical studies in mycorrhizal roots of hydrocarbon yielding plants.
- Interaction between VAM and *Bacillus polymyxa* (PSB) and their effect on growth response.
- Fungicidal effect on VAM colonized experimental plants.*Resinus communis* L (Var: Mysore local).

A brief description of the experimental plants

*Jatropha curcas* L.

*Jatropha curcas* is found in a semi wild condition in the vicinity of the villages, scrubby jungles, rock and pillar site etc. It grows rapidly in dry weather conditions. The plant was introduced in India by Portugues as an oil yielding plant. It is one of the promosing draught tolerant perennial crop and is adaptable to various kinds of soil environment. The work on improvement of *Jatropha curcas* are very limited. India having about 175
million hectares of waste land needs re-vegetation. Mycorrhizal *Jatropa curcas* and *Jatropa gossifolia* are being projected as the ideal plants. Study of the literature survey revealed that 400 litres of oil could be extracted from the yield per acre of 2000 kg in unirrigated area.

*Jatropa gossifolia* L.

It is a small much branched bushy gregarious shrub naturalized almost throughout India. It is now even being considered a potential substitute for diesel.

*Madhuca indica* Gmel (Mahua)

*Madhuca indica* plant commonly known as Mahua is valued for its flower, fruits and seeds since ancient times. The tree is called 'Madhuca' 'Madhudruma' 'Madhupushpa' 'Madhusakha'. The spirituous liquor prepared from the flower is Madhu-madhavi and is described by Susrut in “Susrut Samhita” as astringent, tonic and appetizer. All the parts of mahua tree such as bark, leaf, flower, fruits, seeds and seed oil are used for various purposes. The seed cakes are used as biofertilizers.

and *M. bourdilanh* (Gamble) J.H.Lam. Out of the five species *Madhuca indica* is most widely distributed in the states of Uttar pradesh, Madya pradesh, Gujarat, Andhra pradesh, Maharashtra, Bihar, Orissa and Karnataka. It thrives on all types of soils.

*Ricinus communis* L. (Castor)

Castor is one of the major oil seed crop of India and in fact, India is one the leading producer of Castor crop. The castor export has been fetching 75 crores annually, besides meeting the domestic demand in pharmaceuticals, medicine, industry, soaps, paints, lubricants etc. Inspite of having much potential and scientific technology castor yield /hectare in the country continue to be very low.

This crop is grown as rabi and Karif crops. Two varities of castor have basically classified in Karnataka i.e. Mysore local and Rosa.
Table 1. Profile of five hydrocarbon bearing plants.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Plants Name</th>
<th>Geographic distribution</th>
<th>Height (mtr)</th>
<th>Economic Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Jatropha curcas</em></td>
<td>Small tree, Semi-wild condition in vicinity of villages.</td>
<td>3-4 Mtr.</td>
<td>Decoction of leaves and roots given for diarrhoea root bark is used in external application for sores. Bark decoction used to cure rheumatism and leprosy. Leaf juice used as an external application for piles. Oil from its seeds used as an illuminant since it burns without emitting smoke used as lubricant making soaps and candles.</td>
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<tr>
<td>2</td>
<td><em>Jatropha gossypifolia</em></td>
<td>Bushy gregarious shrub.</td>
<td>0.9-1.8 mtrs</td>
<td>A small much branched shrub. Roots are employed against leprosy, an antidote for snake bite used in urinary complaints. Leaves are used for stomach ache, veneral diseases, eczema, itches. Latex is applied to ulcers.</td>
</tr>
<tr>
<td>3</td>
<td><em>Madhuca indica</em></td>
<td>Medium sized deciduous tree</td>
<td>10-15 mtrs</td>
<td>Leaves are astringent used in embrocation. Wood used for building purposes. Flowers are used for the preparation of vinegar and in the preparation of distilled liquors. Seed oil extensively used in the manufacture of soaps, cooking purposes. Lubricating greces in the manufacture of soaps, cooking purposes. Castor oil is widely used as a cathartic, lubrication, illumination, luxative. Oil is also used in the treatment of acute diarrhoea abortification as a contraceptive creams and jellies. tanneries, soap making.</td>
</tr>
<tr>
<td>4</td>
<td><em>Ricinus communis</em></td>
<td>Annual or perennial bush, occasionally soft wooded tree</td>
<td>3-6 mtrs.</td>
<td>Oil used for lubrication and illumination paints enamels, varnishes. The oil also used in medicinal purposes to cleansing of bowel in menstruating pregnant women.</td>
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<tr>
<td>5</td>
<td><em>Ricinus communis</em> (Var Rosa)</td>
<td>Annual or perennial bush</td>
<td>2-5 mtrs.</td>
<td></td>
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