

INTRODUCTION

1. INTRODUCTION

Mulberry (*Morus alba* L.) being the sole food plant of silkworm, *Bombyx mori* L. bear great economic importance in sericulture. The sericulture industry mainly depends on mulberry productivity and leaf quality. Mulberry leaf protein is used to biosynthesize silk by the silkworm which is made up of two proteins namely 'fibroin' and 'sericin'. It is therefore essential to improve the quality of mulberry leaves in order to increase silk productivity.

Mycorrhizal associations (Fungus - Plant) have generated interest among plant scientists for over a century. The term 'mycorrhizae' was coined by Frank (1885), for the mutualistic symbiosis between roots of vascular plants and certain fungi. Mycorrhiza literally means 'fungus root'. Of the different kinds of mycorrhizae, vesicular-arbuscular mycorrhizae (VAM) is the most prevalent type. The VAM denotes the formation of special structures namely vesicles and arbuscules by the colonizing fungi inside the host plant tissue, especially in the inner cortex of the root. These are non-septate, zygomycetous fungi of the order Glomales. The important genera of VAM fungi are *Acaulospora*, *Entrophospora*, *Gigaspora*, *Glomus*, *Sclerocystis* and *Scutellospora* belonging to the families of Gigasporaceae, Glomaceae and Acaulosporaceae (Morton and Benny, 1990). The VAM fungi are invariably present in all soils in association with a great variety of plants of different taxonomic groups. The great interest in VAM fungi in recent years has prompted numerous surveys aimed at enumerating and assessing VAM fungi in diverse ecosystems. Widespread in their seasonal occurrence and distribution, VAM fungi are a

significant part of every natural and cultivated ecosystems, playing a major role in plant species diversity, survival and seasonal changes (Bergelson and Crawley, 1988).

The role of VAM fungi is well known for their astonishing impact on plant growth and nutrient uptake. A major part of the beneficial effect of VAM is attributed to their role in phosphorus uptake and translocation and increase the resistance or tolerance to drought and root pathogens (Sivaprasad *et al.*, 1990). VA-mycorrhizal fungi are also known to enhance the uptake of nutrients particularly Ca, K, Zn, Cu and S (Bowen, 1980) and nitrogen (Hendrix, *et al.*, 1995; James *et al.*, 1995). The fungi also produce enzymes, auxins, cytokinins and other compounds that increase rootlet size and longevity (Miller, 1971). These beneficial effects of VAM fungi have been reported in many species of leguminous and other crop plants (Aziz and Habte, 1989; Johnson *et al.*, 1991; Muthukumar and Udaiyan, 1995).

Certain mulberry varieties have been reported to be associated with VAM in nature (Kandaswamy *et al.*, 1986; Katiyar *et al.*, 1989; Padma and Sullia, 1991). Mulberry belongs to the family Moraceae and is a hard perennial plant, capable of thriving under a variety of agro-climatic conditions. It grows best in well aerated loamy to clayey loam soils. Similarly, VAM fungi occur in wide range of agro-climatic regions of the world with abundant populations in loamy soils. Since mulberry is a mycorrhizal plant, VAM fungi can very well be utilized for increasing moisture, protein, carbohydrate and other nutrient contents in mulberry leaves besides rendering antagonism or resistance to pathogens. It is well documented that VAM fungi confer tolerance to drought (Nelsen, 1987).

The largest silk producing countries in the world are China and Japan, next to which stands India. At this juncture, when India is competing with China and Japan,

basic research is required for the introduction of better qualities of mulberry plants and produce desirable traits in them, which will greatly help the promotion of sericulture in India. Unlike the temperate regions like Japan, Korea and USSR, South India favours continuous growth of mulberry almost throughout the year, because of optimum temperature conditions and good sunshine available. Unfortunately the quality of silk fibers produced in India is not upto the mark.

One of the main factors that decide the production and profitability in sericulture is maximization of quantity and quality of leaf yield per unit area. In India, the mulberry leaf yields at present are of the order of 4 to 5 metric tonnes and 18 to 20 metric tonnes under rainfed and irrigated conditions per hectare per year respectively. Eventhough the level of leaf production is far below the potential.

The major silk producing and mulberry cultivation states in India are Karnataka, Tamil Nadu, Andra Pradesh and West Bengal in the tropical zone and Jammu and Kashmir in the temperate zone, but Kerala has not gained that status. However, the diverse ecosystems and favourable climatic conditions of the Kerala state are conducive for mulberry cultivation for sustainable sericulture industry. In places like Kerala, where there is a hunt for space, VAM fungi can be effectively used for waste land reclamation, since they enable the plants to utilize the bound forms of nutrients in the soils.

Kerala is a unique geographical unit for the study of VAM fungi, because of its situation (8°0' to 12°48' N latitude and 74°52' to 77°11' E longitude) on the tropical equatorial belt and of its unique diversity of ecosystem broadly characterised into the lowland, midland and highland (Atlas of Kerala, 1984). The ecoclimatic conditions prevailing in various regions of Kerala, lowland considering narrow strip parallel to sea

coast (mainly sandy and sandy loam type), midland considering central area with hills and villages (mainly laterite loam type) and eastern border comprising the high ranges of western ghats considering highland (laterite forest soil combined with humus). The soils are shallow to medium depth in lowland and midland respectively. It is also poor in water holding capacity and low organic matter. Most of the high elevation soils are deficient in available phosphorus but rich in soil bound phosphorus.

Studies on VA-mycorrhizal fungi in relation to their symbiotic relationships with the host plants need to be strengthened, so as to evolve better culture for enhancing the benefits of plant growth under varying ecosystems. VAM fungi, the beneficial companions of plant, if added to the mulberry soils will help to the mulberry plants in extending their root surface in shallow soils, retaining soil moisture and releasing the bound form of phosphorus, thus making it available to the mulberry plants. Hence, the application of these VAM fungi to mulberry soils will greatly influence the quality of leaves and inturn the growth of the silkworms and the quantity and quality of cocoons production.

Therefore, the present work pertains to study the seasonal variations of VAM fungal spores and sporocarps in rhizosphere soils supporting mulberry (*Morus alba* L.) plants from unique physiographical zones with three different ecosystems, all within a small area which provide a ideal locations of Kerala state, India in relation to soil physico-chemical characters. It includes a survey of the occurrence of VAM in rhizosphere soils of five cultivars of mulberry at three different ecosystems viz., lowland, midland and highland of Kerala state were studied. Different aspects such as physico-chemical characterization of their soils, VAMF colonization, host specificity, characterization of spores and sporocarps and fungal-plant associations were also

investigated. The correlation between the percent root colonization and VAMF spore abundance among soil physico-chemical characteristics as well as between VAMF spore abundance and soil physico-chemical characteristics were examined. The dominant strains of VAM fungi in this study was evaluated and to determine the selection of efficient strain of VAM fungi using *Allium cepa* L. for bioassay efficiency and mass inoculum production of the selected strains. Two different set of experiments were conducted with the effect of indigenous and introduced and indigenous VAMF species on growth, biochemical and nutrition of mulberry cultivars MR2 and Kanva2 respectively. Further to study the evaluation of VAM treated mulberry leaves by silkworm rearing performance was also monitored.