INTRODUCTION
The rhizosphere and rhizoplane are inhabited by large number of micro-organisms whose activities are of great relevance to plant growth. Among these, the micro-organisms which form relationship in the endorhizosphere are well placed to influence plant behaviour. Doing so, they become an integral part of roots and in consequence considerably modify the activities of these absorbing organs. Of the various plant-microbe interactions the most prevalent and the widespread type of association is the "Mycorrhiza". Although seven types of mycorrhizae are recognized viz., ectomycorrhizae, arbuscular, ericoid, arbutoid, monotropoid, orchid and E-strain mycorrhizas, the most prevalent and wide spread type of mycorrhiza in the plant kingdom are the arbuscular mycorrhizae (Peterson and Farquhar, 1994). More than 80% of plant species including most agricultural, horticultural, plantation crops (Maronek, 1981; Barea et al., 1993) and forest trees (Grove and LeTacon, 1993; Haselwandter and Bowen, 1996) are capable of forming arbuscular mycorrhiza.

It is now well known that these organisms are ubiquitous in distribution found in nearly all ecosystems throughout the world ranging from the artic to the tropical rain forest (Bledose et al., 1990) and in diverse habitats from aquatic to desert ecosystems (Peat and Fitter, 1993; Dhillion et al., 1995). Disturbed habitats may support relatively little natural colonization by mycorrhizae (Hayman, 1982). In fact the underground parts of large majority of plants growing under natural condition do not exist simply as roots but as arbuscular mycorrhiza, and is a determining factor for plant establishment and survival in many ecosystems.
Mycorrhiza, are critical components of the root soil interface. These fungi are present quite consistently on the root surfaces or in the tissues or cells of the roots of many species so that dual organs of consistent morphological and histological patterns are formed. They conform to a number of common kinds the world over, and in them the fungus and the host co-exist in a physiologically, ecologically and reproductively active state for long periods, a state called mutualistic symbiosis. Table 1 summarizes the characteristics of the common kinds of mycorrhizae. These symbiotic associations that participate in the uptake of phosphorus are involved in pioneer colonization of nutrient deficient sites (Harley, 1970).

Arbuscular mycorrhizal fungi belong to Class Zygomycetes in the order Glomales (Motan and Benny, 1990), form characteristic structures viz., arbuscules and vesicles within the host roots, dimorphic branching of extramatrical hyphae (Mosse, 1963; Nicolson, 1959) and production of large numbers of chlamydospores and azygospores in the soil. Arbuscular mycorrhiza develops when a hypha from a spore or an already colonized root contacts a suitable host root (Powell, 1976). The development of arbuscular mycorrhizal fungi in root can be divided into four stages (Tommerup and Briggs, 1988).

a) Spore germination and hyphal growth from colonized propagules of arbuscular mycorrhizal fungi.

b) Growth of hyphae through soil to host roots. The mycelial system surrounding the roots is dimorphic (Mosse, 1959; Nicolson, 1967).

c) Penetration and successful initiation of colonization in roots. Hyphae penetrate mechanically and enzymatically into cortical cells (Kinden and
Table 1: Characteristics of important kinds of mycorrhizas in their mature state (Harley, 1989).

<table>
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<th>Character</th>
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<th>Arbutoid</th>
<th>Monotropoid</th>
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| Host Taxon                      | Bryo, Pterido, Gymno, Angio, (Pterido) | Gymno, Angio | Ericales | Monotrop-aceae | Ericales | Orchid-aceae |

**Legend:**  
+ = Present  
- = Absent  
(·) = rare
Brown, 1975). At the point of penetration, hypha may or may not form appressoria (Abbott, 1982).

d) Spread of colonization and development of internal hyphal system, arbuscules, which bifurcate inside a cell and bring about nutritional transfer between two symbionts and vesicles which, develop as terminal or intercalary swellings in inter- or intra-cellular hyphae. They are responsible for storage and vegetative reproduction.

Six genera viz., *Acaulospora, Entrophospora, Gigaspora, Glomus, Sclerocystis* and *Scutellospora* are currently recognized. Among these, *Gigaspora* and *Scutellospora* do not form vesicles inside host roots. Being obligate symbionts, arbuscular mycorrhizal fungi are unable to grow in pure cultures. Attempts to cultures them on artificial media have met with little or no success (Hepper, 1984; Tommerup, 1988; St. Arnaud *et al.*, 1996).

The role of arbuscular mycorrhizal fungi in phosphorus acquisition of plants has been well documented for more than two decades. In general, most large growth enhancement effects of root colonization with mycorrhizal fungi are caused by increases in phosphorus absorption, particularly from sparingly soluble phosphorus sources (Bolan *et al.*, 1987). When root exploration is restricted upto 80% of the plant phosphorus can be delivered by the external arbuscular mycorrhizal fungal hyphae to the host plant over a distance of more than 10 cm from the root surface (Li *et al.*, 1991).

Besides this increase in spatial availability of phosphorus, effective phosphorus acquisition by the external hyphae is related to
a) Formation of polyphosphates in the hyphae, and thus, maintaining low internal phosphate (Pi) concentration.

(b) The small hyphal diameter leading to a relatively larger soil volume delivering phosphorus per unit surface area compared to the root surface (Jungk and Claassen, 1989) and a correspondingly 2-6 times higher phosphorus influx rate per unit length of hyphae (Jakobsen et al., 1992).

With respect to phosphorus nutrition, the growth response to arbuscular mycorrhizal colonization depends on soil and plant factors which determine the phosphorus acquisition of the host plant, extent of phosphorus deficiency-induced root response and the phosphorus status of the soil. With increasing soil phosphorus, the growth enhancement effect of arbuscular mycorrhizal fungi declines and may either be abolished or lead to growth depressions. When arbuscular mycorrhizal fungi improve phosphorus nutrition of the host plant there may be a corresponding increase in nodulation, nitrogen fixation and growth (Robson et al., 1981).

Arbuscular mycorrhizal fungi have been shown to help plant to acquire other macronutrients like N, K, Ca, Mg, S (Azcon, 1994; Marschner and Dell, 1994) and micronutrients such as iron, copper, Manganese, Zinc, Boron (Bethenfalvay and Franson, 1989; Kothari et al., 1991; Tobar et al., 1994). The high efficiency in nutrient uptake by mycorrhizal roots is mainly due to the activity of the hyphal network developing from the root into the surrounding soil which can absorb these nutrients, transport them to the root and release them into the host cells. So mycorrhizal roots have a much greater absorbing potential surface than non-mycorrhizal roots, since they
can exploit nutrients in the soil beyond the depletion zone which forms at the root surface.

Arbuscular mycorrhizal fungi have also been shown to increase water uptake and/ or otherwise alter the plants physiology to reduce stress response to drought and salinity. (Nelsen, 1987; Weissenhorn et al., 1993, Subramanian et al., 1995). There are evidences that arbuscular mycorrhizal fungi decrease metal accumulation in plants growing in polluted soils and thus protect the host against the phytotoxic metal effects (Arines et al., 1989; Leyval et al., 1991; Weissenhorn et al., 1993).

The improved nutrient uptake and better water utilization in endomycorrhizal plants reduce the transplant shock, quick recovery after temporary wilting and survival after transplanting (Biermann and Linderman, 1983; Michelsen and Rosendahl, 1990). Hormone production is affected by arbuscular mycorrhizal formation (Allen et al., 1980) and the resultant changes in hormone quilibrium leads to development modification in arbuscular mycorrhizal plants viz., a higher production of floral buds, retarded leaf fall in deciduous woody plants and alteration in partitioning of root and shoot biomass (Gianinazzi-Pearson, 1989). An interesting arbuscular mycorrhizal effect is the increase in resistance and tolerance of arbuscular mycorrhizal plants to soil Pathogens (Menge, 1982; Liu, 1995) and pests such as nematodes (Smith, 1988; Price et al., 1995). Increase in synthesis of secondary metabolites like lignin, ethylene, phenols as well as phytoalexins in mycorrhizal plants may contribute to these protective effects (Dehne, 1982 & 1986; Morandi et al., 1984; Morandi and Gianinazzi-Pearson, 1986).
Changes in density and composition of the rhizosphere mycoflora due to arbuscular mycorrhizal colonization are well documented (Secilia and Bagyaraj, 1988; Linderman, 1988; Paulits and Linderman, 1991). In legumes there is increased nodulation and nitrogen fixation in mycorrhizal root system as a result of plant's improved P nutrition (Barea et al., 1987; Patterson et al., 1990; Reinhard et al., 1994). The improved N, P and micronutrient nutrition of plants by arbuscular mycorrhizal fungi causes secondary effects on the absorption of mobile ions like K, S and HNO₃, and there is an overall modification in the cation-anion balance. Early insight into the role of arbuscular mycorrhizal fungi suggests the role in enhancing soil aggregation, reduction in soil erosion and increased water holding capacity (Thomas et al., 1993; Tisdal, 1994).

A certain number of management practices can affect mycorrhizal development and function. Heavy fertilization and use of pesticides, especially biocides and fungicides can greatly reduce arbuscular mycorrhizal fungal population and mycorrhizal colonization levels (Douds et al., 1993; West et al., 1993; Udaiyan et al., 1995.) Others like disinfectants, micropropagation techniques or the use of soilless potting mixes completely eliminate arbuscular mycorrhizal fungi and cause stunting or transplantation problems for mycorrhizal dependent plant species (Niemi and Vestberg, 1992).

Many ecosystems are in various state of decline by erosion, low productivity and poor water quality caused by forest clearing, intensive agricultural production and continued use of land resources for the purpose that are not sustainable (Allen et al., 1995). The biological diversity of these systems is being altered. Sieverding (1989) has pointed out that when soils with perennial plant species are cleared for cultivation,
species of arbuscular mycorrhizal fungi belonging to \textit{Sclerocystis} tend to disappear. Biological diversity apart from animals has been mainly concentrated on plant diversity, but little is known about the richness of the mycorrhizal fungi with which plants are associated. Eventhough, mycorrhizae regulate plant diversity they do not follow the patterns of plant diversity (Allen \textit{et. al.}, 1995).

The State of Goa with an area of approximately 3702 sq. km is one of the smallest State of India (15° 48' 00" N and 14° 53' 54" N Latitude and 74° 20' 13" E and 73° 40' 33" E Longitude) lies in the central portion of Western Ghats which extend from the Tapti River (Gujarat) in the north down to the peninsular tip of South India and is one of the bio-diversity hot-spots in the world. In Goa, the environment as a whole has suffered, mainly due to urbanization ans so called “development”. Severing the close links between plant and soil microorganisms has contributed to degradation of many ecosystems. The re-establishment of functional ecosystems presumes knowledge of micro-elements of the system and therefore they must be studied to understand the ecosystem changes. No effort seems to be directed to isolate and identify the native arbuscular mycorrhizal fungi in the forest areas of Goa.

Although arbuscular mycorrhizal fungi can be used to enhance plant productivity, many concepts of arbuscular mycorrhizal fungal application cannot be adequately assessed or manipulated in a rational way for field application without the knowledge of their taxonomy and ecology. Also the potential importance of plant and soil inhabiting arbuscular mycorrhizal fungi to natural ecosystem and low cost agriculture and horticulture justifies the persuit of an understanding their taxonomy and
ecology. But much still remain to be learnt about these wide spread association. Hence, the present investigation was undertaken with the following objectives.

1. To study the dynamics of root colonization and to determine spore density of arbuscular mycorrhizal fungi, occurring in Mollem and Dharbandoda forest areas.

2. To study the arbuscular mycorrhizal fungal diversity in the rhizosphere soils of various plant species of Mollem and Dharbandoda forest areas.

3. To study the ecology and taxonomy with respect to edaphic factors of arbuscular mycorrhizal fungi associated with some plant species from Mollem and Dharbandoda forest area.

4. To study seasonal variations of arbuscular mycorrhizal fungi with respect to root colonization and spore density.

5. To study the effect of selected arbuscular mycorrhizal fungi on growth and productivity of selected forest tree species.