CHAPTER I

INTRODUCTION
Fungi constitute an important and integral component of the ecosystems in nature. Being heterotrophs, they exist on a wide range of habits and habitats such as the decaying remains and living parts of plants and animals, in soil, dung, air, freshwater and the sea and exhibit a great diversity in form and function. As saprophytes, along with bacteria and micro- and macrofauna, fungi bring about complete decomposition of plant and animal remains. As parasites, they cause diseases in plants and animals. As mutualists, fungi are known to live in harmony with other organisms; as endophytes, they are believed to extend support in providing defence and endurance to living plants. It is now known that with their grand species composition and ability to produce a variety of enzymes and establish simple to complex ecological association with plants and other organisms, fungi act as fine tuners of the structure, function and dynamics of plant and animal community in nature (Dix and Webster, 1995).

**Diversity:**

Of the estimated 1.5 million, 72,036 species of fungi have so far been described and documented (Hawksworth, 1991; 1997). Communities of saprophytic, parasitic, mutualistic and endophytic fungi living in the wild contributed significantly to species diversity (Frankland, 1998). Recent studies have revealed that tropical plant substrate and habitats harbour diverse microfungi in abundance (Hyde, 1997). Investigations have pointed out that the microfungi of the tropics are possible sources of biotechnologically significant, pharmaceutically important and industrially valuable organic molecules (Dreyfuss and Chapela, 1994; Rossman, 1994; Bills, 1995). Taking a clue from these utilitarian points of observations, Bills (1995) and Hawksworth (1997) made an
emphatic plea for urgent and comprehensive documentation of and investigation on the fungi of various habitats in the tropical region.

Several studies on diversity of fungi associated with plant and animal substrates are available (Ellis, 1971, 1976; Ingold, 1975; Lundqvist, 1972; Matsushima, 1971, 1975; Sivanesan, 1984; Subramanian, 1971, 1983; Sutton, 1980). Amongst these, a few were directed at measuring the abundance, besides diversity, of microfungi that inhabit plant litter (Heredia, 1993; Wicklow and Carroll, 1981). A few investigations were carried out to elucidate the process of decomposition of plant litter in a variety of habitats (Barlocher, 1992; Wicklow, 1981, 1992; Dickinson and Pugh, 1974).

Recent studies have revealed that decomposing litter, live plant parts and their habitats in the tropics harbour fungi in abundance (Bills, 1995; Hyde, 1997; Bills and Polishook, 1994). Relative to the understanding of extent of diversity, ecology, geography and biochemical functioning of terrestrial plants and animals, knowledge on the microfungi so far remained less understood.

**Ecology:**

Aerial plant surface as a habitat for fungal growth has been first recognized by Last (1955). The decay of plant parts, in which fungi exerting a decisive role in the release of nutrients is generally completed in the soil but set in motion in senescing organs before they are shed. That is, of the many fungal spores impacted on the aerial surface, a few succeed in colonizing and growing on the leaf tissue (Frankland, 1998).

Fungal endophytes live within the tissues of higher plant leaves, twigs, bark and root. They do not cause any visible symptoms on host plant. The endophytes associated with temperate tree species have been studied since the middle of 1970's but not much is
known on diversity, ecology and biology of endophytic fungi from the tropics. Dreyfuss
and Chapela (1994) and Bills (1996) observed that the fungal endophytes within the
tissues of higher plants exhibit notable diversity and proposed that a comprehensive
investigation on green and senescing leaf-tissue and decaying leaves would give a
complete picture on the form and function of mycoflora associated with plant species.

Although earlier studies on the ecology of fungi were concentrated on soil and
soil organic matter, later investigations were directed mostly on understanding the
relationship of fungi with plant litter (Hudson, 1968; Dix and Webster, 1995). It is now
well established that the ability of fungi to grow on a particular plant substrate is
determined by their role in decomposition of the organic matter. Besides the chemical
composition, environmental factors such as temperature, moisture content, availability of
nutrients and energy-source, regulate the process of litter decomposition. It is known that
no single species of fungi is able to use all components of plant litter completely and
different fungi appear in succession on the substrate over a period of time in order to
decompose the organic matter and release the bound nitrogen back to nature. Abundant
literature is available on colonization of living plants as well as their dead remains by
fungi, both in the temperate and tropical habitats (Kendrick, 1992; Dix and Webster,

Activity:

The colonization and subsequent decomposition of plant substrate depended as
much upon on the ability of the fungi to produce enzymes necessary to degrade
particular plant polymers. The degradation of the substrate is achieved only through a
range of enzymes produced by the fungi and other microorganisms. There is a growing
realization that fungi inhabiting plants, living tissues and fallen leaf litter produce enzymes and secondary metabolites which besides have many uses and application in industry and human welfare (Rossman, 1994; Dreyfuss and Chapela, 1994; Bills, 1995; Dix and Webster, 1995).

**The Present work:**

Considering the vast array of plants and a wide range of vegetation types distributed along the Western Ghats' forests in southern India, it is presumed that a high degree of fungal diversity may be present in this region. Encouraged by positive results obtained from an earlier study carried out in this Laboratory by Miriam (2000) on *Ficus benghalensis* Linn. and *Carissa congesta* Wight, an additional effort is made in this thesis to investigate and present information on studies on the diversity, ecology and activity of the microfungi associated with several dicotyledonous and monocotyledonous plant species of the forests of Western Ghats in Goa region.

The work has focused on the following key objectives:

- Taxonomy, diversity and substrate specificity of litter and endophytic microfungi associated with different plant species.
- Seasonal occurrence and species richness of fungi in relation to four selected plant species.
- Ecological succession of microfungi on litter of *Careya arborea* and *Dendrocalamus strictus*.
- Assaying of cultures of isolated fungi for enzymes.

Litter and endophytic microfungi associated with 4 native plant species of the Western Ghat forests in Goa State, namely *Saraca asoca* (Roxb.) de Wilde:
Leguminosae; Caesalpinoideae (dicot) and Calamus thwaitesii Becc.: Arecaceae (monocot) in Bondla wildlife sanctuary and Careya arborea Roxb.: Lecythidaceae (dicot) and Dendrocalamus strictus Wall.: Poaceae (monocot) from Molem wildlife sanctuary, were studied during the pre-monsoon (February–May), monsoon (June–September) and post-monsoon (October-January) period of 1999-2001. In addition, several widely distributed plant species of the Western Ghat forests of Goa were scanned extensively for associative litter and endophytic fungi.

A detailed review of literature on diversity, taxonomy and ecology of litter and endophytic fungi precedes the results presented in the thesis. State-of-the-art techniques used to recover the fungi associated with the plant parts are detailed out in Chapter III. A novel ‘litter-bag incubation experiment’ was conducted to study the succession of microfungi on the substrate. Along with morphological and cultural characters, diagnostic ecological and habitat features were considered in distinguishing the taxa. All these information were compiled using a specially prepared ‘database’ on terrestrial fungi.

Standard and relevant literature on taxonomy was referred for identification of the fungi. The diversity and abundance of these fungi in different plant species were statistically analysed and discussed. Dried specimens were housed at the Herbarium of Botany Department, Goa University, and cultures maintained at the Goa University Fungus Culture Collection. The litter and endophytic fungi were screened for various enzymes following standard techniques.

The results are detailed out and discussed in four parts in the thesis. A comprehensive list of references and a list of papers published during the study period are appended at the end of the thesis.