INTRODUCTION
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Dharwad is one of the districts in Karnataka, India. Dharwad is a district place situated on Poorna-Bangalore track. The area is known as Chotamahabaleshwar where the Karnatak University is situated. The climate in general is comparatively cooler than the outer parts of Dharwad city and is often exposed to winds. The vegetation as such is completely disturbed because of many factors mainly biotic. The vegetation is under gradual transition which is manifest by relicts like Anogeissus latifolia, Tectona grandis, Terminalia chebula, Semicarpus anacardium and Bambusa species.

The Dharwad region and especially the Ghat sections are very rich in plant material of varied types and are of interest to taxonomists, plant geographers, foresters, etc. Saldhana (1984) has pointed out the importance of the flora of this region since it is rich not only in angiospermic vegetation but also in Algae, fungi, Bryophytes and Pteridophytes.

Changed environmental (Macro and Micro climatic) conditions due to geographical variations are known to affect the association between plant pathogens and their exotic hosts. This may also
be true with the associated saprophytic fungi, which ultimately bring out the decomposition of leaves and litter. Fungi along with other microflora and microfauna play a key role in the biological processes.

Litter has the common use meaning associated with discarded beer cans and picnic wrappings but plant litter having no common language use, is not be devilled by the ramifications of a complex ethymological history. In ecology it is nevertheless used with two meanings the layer of dead plant material which may be present on the soil surface; and dead plant materials which are not attached to a living plant. The litter layer may be clearly distinguishable from an underlying mineral layer or there may be no sharp boundary between a layer containing recognizable plant structures and a layer containing only amorphous organic material. The problems are no less severe when litter is defined as dead plant materials. Plant organs neither die instantly nor, when dead fall instantly. Abscission of a leaf follows a more or less prolonged senescence when much of the mineral content is withdrawn to the stem and the phylloplane fungi are already decomposing the available carbohydrates. In ecosystem compartment models, dead materials still attached to the living plant are distinguished from litter as standing dead but as in the distinction between litter
and soil organic matter, the category is no more than an analytical convenience. Litter decomposition is not a discrete process operating on a specific class of materials such discontinuities in space and time rarely exist in nature. Any definition of litter decomposition must therefore be recognized for what it is, an arbitrary and mutable work tool.

Litter decomposition is relevant to many aspects of ecology, Traditionally ecologists have taught the concepts of Graphic levels and food chains from the plant herbivore-carnivore-parasite sequence but a marked feature of contemporary teaching is its increased awareness of the proportion of primary production that passes through the decomposer channel. Litter decomposition is no less relevant in applied ecology, the central issue being the long-term effect of departures from traditional agricultural and forestry practices which returned a large proportion of organic production to the soil.

Plant litter is composed of six main categories of chemical constituents (1) Cellulose (2) Hemi-Cellulose (3) Lignin (4) Water-soluble sugars, aminoacids and aliphatic acids (5) Ether and Alcohol soluble constituents including fats, oils, waxes, resins and many pigments and (6) Proteins. The breakdown of these
constituents is effected as a sequence of specific reactions with the enzyme systems of specific organisms. Because many species have broadly similar enzyme complements they can be classified in physiological groups which follow a succession as the litter decomposes (Webster and Dix, 1957).

Initially, the phylloplane fungi attack the easily decomposable sugars exuded from the leaf surface or released by aphids and other insects from sub cuticular tissues. As the leaf becomes senescent the phylloplane fungi which individually or in combination possess cutinase, pectinase and cellulase, penetrate the cuticle attack the middle lamellae and begin to disintegrate the cell walls (Pugh et al., 1972; Bell, 1974; Jensen, 1974). The pattern of distribution of decomposer species and the rate of decomposition of senescent leaves and standing dead litter are determined largely by humidity. In the humid conditions of tropical rain forest the phylloplane flora may contain up to $20 \times 10^6$ bacteria cm$^{-2}$ of leaf surface besides an assemblage of Actinomycetes, Fungi, Yeasts, Lichens and Protozoa (Ruinen, 1961).

In temperate regions, as the litter falls from the standing plant to the more stable humidity of the litter layer, decomposition accelerates. About 20-40% of litter is cellulose, structurally
organized in microfibrils made up of long polymer chains of glucose. Although many of the saprophytes in the litter layer and soil can be classed as cellulolytic only a few can decompose native cellulose.

Hemicelluloses are second only to cellulose as constituents of plant litter. They bear no structural relationship to the cellulose molecule but derive their name from their occurrence as an amorphous mass around the cellulose strands. Fungi, Actinomycetes and Bacteria decompose hemicellulose which breaks down faster than cellulose under both aerobic and anaerobic conditions. Under aerobic conditions, fungi are generally the dominant hemicellulose oxidizers but the initial populations in rotting straw and manure are generally strains of Bacillus. Since there are many hemicelluloses and related Polysaccharides in plant litter, there are many hemi-cellulose depolymerizing enzymes, but a fuller understanding of their differences awaits information on the chemistry and fine structure of the substrate (Alexander, 1961).

Lignin the third major constituent of plant litter forms about 5% of succulent plant material and about 15-35% of the wood of most trees (Kaarik, 1974). The outstanding characteristic of lignin as a litter component is its resistance to microbial decomposition.
Lignin in fresh plant litter occurs in the secondary layers of the cell wall and to some extent in the middle lamella. Undoubtedly the main decomposers are white rot Basidiomycetes such as *Polystictus versicolor* and *Fomes fomentarius*, but lignin utilization is known or suspected in a variety of Ascomycetes, Actinomycetes and several groups of bacteria.

In the IBP Handbook methods of study in Quantitative Ecology, litter was defined (Medwecka-Kornas, 1971) as material lying on the soil surface composed of dead plants and shred organs but not standing dead matter. Rodin and Bagzilevich (1967) listed components of leaf litter as including flowers, leaves, glumes, seeds, fruits and small twigs. Most estimates of litter fall have involved the leaf fraction in isolation from all other components.

The pattern of colonization of senescing and dead tissue has been discussed by Hudson (1968) and Garrett (1970). A model suggesting sequential colonization of senescent and dead tissue was developed; this associated weak parasites with senescing tissues and a primary and secondary saprophytic flora with the utilization of simple carbohydrates and eventually of cellulose and lignin. On leaves and stems many taxonomic and descriptive studies of fungi have listed the substrate from which
they were isolated (Jones 1962, 1963; Lind 1934). Microorganisms have been isolated from litter including leaf and stem debris (Anastasiou and Churchland 1969; Jones 1962, 1963; Ingold 1954, 1958, 1959a,b). Some of this debris has been collected from specialized environments including streams (Ingold 1942, 1943; Nilsson 1964; Peterson 1962; Tubaki 1957; Ranzoni 1953) lakes (Cunnell 1956) and salt marshes (Johnson 1968).

The surfaces of leaves and stems provide landing sites for a variety of airborne microorganisms, pollen grains (Fokkema 1968, 1971; Warren 1972) and inert particles. Plant surfaces vary morphologically with ridges and furrows, plates of wax, hairs, glands and other features (Martin and Juniper 1970). Not all particles landing there are securely attached and many spores and other propagules may be redisseminated by rain, mist or dew (di Menna 1959) by air currents or by thermal movements (Barnes 1969). The leaf surface, first termed the phyllosphere (Last 1955; Ruinen 1956) is now called the phylloplane (Karling 1958; Leben 1965). Though securely lodged on the leaf surface organisms may not be able to germinate and colonize this environment, and these form the causal element (Leben 1965). Their inability to grow on the leaf surface may be attributed to physical factors (Ruinen 1970), to a lack of essential nutrients.
(Barnes 1969; Diem 1969; di Menna 1962) to host specificity (Karling 1958; Last and Deighton 1965) to competition between the resident organisms or to the condition of the host (Jones 1968). In leaf studies, more attention has been paid to fungi and less to the bacteria. Saprophytic species of *Cephalosporium*, *Chaetomium* and *Saccharomyces* occur in vascular tissues of plants (Matta, 1971).

The phylloplane as a habitat for saprophytic or weakly parasitic microorganisms has been a rather neglected field of study as was pointed out by Ruinen (1961) but since then a considerable amount of literature has been published (Last and Deighton 1965; Leben 1965; Preece and Dickinson 1971; Pugh 1974).

It has been shown that tree leaves are invaded by microorganisms very rapidly after unfolding. The phylloplane microflora in deciduous stands consists of relatively few species, especially at the beginning of the growing season. This indicates a rather extreme environment. Probably due to the exposure to changing weather conditions, the limited availability of nutrients and possibly the presence of antimicrobial substances (Topps and Wain 1957; Beck *et al.* 1969). Usually, the selectivity of the phylloplane
environment diminishes during the growing season. It is also much less pronounced in the humid tropics than in cool temperate regions. The phylloplane microflora probably reaches its maximum development in tropical rainforest (Ruinen 1961, 1963).

Litter production and composition are highly variable and have been comprehensively reviewed by Bray and Gorham (1964). Annual litter fall varies considerably from one forest type to another. Rates expressed as t ha⁻¹ year⁻¹, vary from 5.5-15.3 in equatorial rain forests, to 2.9-8.1 in warm temperate forests to 1.0-6.9 in cool temperate forests. In arctic conditions the range is 0.6-1.5. Production also varies during the year but the seasonal pattern varies throughout the world. In equatorial regions litter fall is continues throughout the year with most in the first six months. If dry season occur, leaf fall can increase. In the warm temperate forests of Eastern Australia, leaf fall is again continuous with maxima in spring and early summer when temperature and precipitation rise. Maximum leaf fall in warm temperate forests of North America occurs in autumn as the temperature decreases. The most striking seasonal patterns occurs in cool temperate forests, where autumnal cooling can lead to almost complete leaf fall in deciduous species. With gymnosperm the pattern is more variable. Finally it should be noted that litter production
may vary from year to year. Within litter, the proportion of the
different components varies from one litter type to another. It is
clear that litter of different plants does not decompose at the
same rate even under similar environmental conditions. This is
undoubtedly due to differences in the structure and composition
of their leaves and other parts. Leaves of coniferous trees are
generally decomposed more slowly than those of deciduous trees.

Litter of deciduous trees usually decomposes more rapidly
but considerable variation occurs between different types. Dickinson
and Pugh (1974) included *Fraxinus americana* L. and *Betula
papurifera* Marsh among fast decomposers and *Fagus grandifolia*
Ehrh among the slowest. Dickinson and Pugh (1974) observed
that leaves of *Betula verrucosa* Ehrh and *Tilia cordata* Mill. were
more rapidly decomposed than those of *Quercus robur* L. and
*Q. petraea* Liebel. Comparison of decomposition rates on different
sites showed that they were Faster on mull sites although the
relative rates of various species were generally similar on all
sites.

For the present work I have selected Ten plants for the
study of litter fungi. They are (1) *Citrus aurantium* L. (Rutaceae),
(2) *Thevetia nerifolia* juss (Apocynaceae), (3) *Ficus benjamina* L.
Although these plants are widely grown in India during the last three decades there has been so far no critical or intensive work on the taxonomy or ecology of fungi colonizing the leaf litter of these exotic plants in their artificial ecosystem. The very interesting fungi reported by earlier workers who have investigated these substrates elsewhere and also the several interesting records of litter fungi that have appeared in the recent past were suggestive of the great possibilities that lie before Indian students of mycology to pursue this line of study. Hence it was felt that this would be a most worthwhile project to investigate and studies were undertaken on the taxonomy, ecology and physiology of fungi colonizing leaves and litter of various plants in and around Dharwad during 1994-1997, the results of which are presented in this thesis in three parts. Part-I deals with the taxonomic studies of fungi colonizing leaf litter belonging to ten species collected from different areas of Dharwad. The results of ecological studies aimed at understanding the pattern of fungal colonization of leaves and
leaf litter of the various plants are presented as part II of the thesis. Physiological studies of those fungi which have been collected from leaf litter are presented in the Part III of the thesis.

These ten plants were selected mainly for their role in economic uses.

**Citrus aurantium** L. (Rutaceae). It is known as sour orange. It is a native of South Eastern Asia. The flowers are exceedingly fragrant and are the source of the oil of nevoli used in perfumes. It is very susceptible to cold and is distinctly tropical plant. It is a low struggling shrub or small tree with numerous very sharp spines and small white flowers. The sour orange or lime is one of the sourest fruits in the market and it is not suitable for eating. It is grown chiefly for the Juice, which is often extracted and shipped in a raw or concentrated form. Lime Juice is used in beverages as a source of citric acid and medicinally to prevent scurvy. Lime juice actually contains only one quarter as much vitamin C as either oranges or grape fruit. Limes are grown to some extent throughout the tropics and are of commercial importance in Mexico, Egypt, the West Indies.
**Thevetia nerifolia** juss (Apocynaceae). It is a common bush or sometimes a small tree. It is a native of South America and West Indies often in consequence of its rapid growth, used for hedges. It has oleander like leaves, yellow fragrant, flowers, and a fruit the size of a crab apple. It is sometimes called the yellow oleander. The milky Juice of the tree and the kernels of the fruit are poisonous, the bark is bitter.

**Ficus benjamina** L. (Moraceae). An evergreen tree with a dense divaricate crown and pendulous branches, all parts glabrous. In malabar, a decoction of the leaves mixed with oil is applied to ulcers. The milky juice is used against whitening of the cornea by the mundar of chota nagpur. When a baby's eyes get white, they mix some of the juice with the mother's milk and instil about two drops of this mixture in its eyes.

**Psidium guajava** L. (Myrtaceae). The well known Guava tree, a native of Mexico and possibly other parts of tropical America, is cultivated throughout and naturalised in India and in most tropical countries. It is valued for its fruit and is deserving of more attention than it generally receives. The guava is a very aromatic, sweet, juicy and highly flavoured fruit with a fine balance between the content of acid, sugar and pectin. It is one of the
richest sources of vitamins A, B and C. It is usually used for Jellies, preservers and pastes, but is equally good as a fresh fruit. The powder from dehydrated fruit is used to fortify other Jellies and Jams.

*Agave sisulana* Perr (Amaryllidiaceae). It is commonly known as sisal plant. It is quite similar to henequen in appearance but lacks the spines on leaves. A native species of Mexico and Central America. The plant is exceedingly drought resistant and will grow where all other species fail. Light yellow to white fibers are removed from the leaves by hand or by means of a raspador. They are cleaned, dried and packed in bales for shipment. The united states uses a large amount of sisal for twine, ropes and cards.

*Swietenia mahagoni* L. (Jacq.) (Meliaceae). The plant mahagoni is the most important export wood in tropical America and is the source of the world's most valuable timber and premier cabinet wood. It was used for woodworks as early as A.D.1514. The cathedral of Santo Domingo built in 1550, contains some beautiful Mahagony Carvings still in excellent condition. The early Spanish explorers utilized the timber construction in England as early as 1680. The plant is commonly used for furniture, fixtures
musical instruments, mill work, cars, ships and boats, caskets, air planes and plywood.

**Acacia melanoxylon** R.Br. (Mimosaceae). The plant is an evergreen tree with a dense divaricate crown and pendulous branches. This tree shows a wide range in size. Wood of *Acacia melanoxylon* is also known as Blackwood. Blackwood is one of the most ornamental of Australian timbers. It's principal uses are cabinet and decorative work. The tree is suitable for planting for ornament, shade and shelter.

**Bombax malabaricum** DC (Bombacaceae). It is a tall deciduous tree. The cotton obtained from the capsules, though not well adapted for spinning is an excellent material for filling beds, cushions and pillows, for which purpose it is extensively used in India and under the name of Simal exported to Europe. A gum called Mocharas employed in native medicine, is also a product of the tree, while the inner bark affords a fibre which can be used in the manufacture of cordage.

**Achras sapota** L. (Sapotaceae). It is one of the best dessert fruits of tropical America. The tree is a stately evergreen plant with large rough brown fruit. The yellowish brown flesh is
translucent and very sweet and wholesome. Young fruits contain considerable tannin and are unpalatable. The chief commercial product of the tree, however, is not the fruit but the milky latex, which is the chief source of chicle.

*Gliricidia maculata* HBK (Papilionaceae). A small or medium sized tree with a short bole, introduced into India primarily as a shade tree in Plantations, it is valued as a source of green manure for paddy in Madras and has been recommended for cultivation on bunds of fields. The tree is quick growing and may be propagated by seeds or cuttings. The tree is valued for the large quantity of green material it produces. The loppings are rich in nitrogen; tender twigs and leaves are richer in manurial constituents. The leaves are also used as fodder. The wood is durable and is used for house posts, fences, etc.

A detailed and comprehensive survey of litter fungi of ten plants from Dharwad region is undertaken by the present worker due to their peculiar habitat and their role in the ecosystem. The results of the study are represented in this work. It is well known that floristic work or mycoflora of a particular region is the most neglected aspect of the mycological study. Such studies are generally considered as merely of academic interest. However,
it is well established fact that the knowledge of occurrence and
distribution of population of various fungi in a particular habitat
is of immense importance for proper understanding of potentially
economically important fungi.

The work carried out by the present worker no means be
claimed as a complete one and hence further survey of this
area is highly desirable which could throw some light on many
more unrecorded and undescribed fungi, only the collected forms
have been described in the text.

Even though the title of the thesis refers to the litter fungi
of Dharwad the present investigation were confined to taxonomy
of litter fungi, ecology and certain physiological aspects of litter
fungi of this region.

The present investigation deals with the taxonomy of litter
fungi ie. Phycomycetes, Ascomycetes and Deuteromycetes their
seasonal occurrence, colonization pattern. The growth of some
of these organisms were also studied by culturing them on different
media. The investigation also includes the nutritional studies ie.
utilization of some carbon and nitrogen sources by few organisms
which were isolated during the study.