STUDIES ON FOLIICOLOUS FUNGI ASSOCIATED WITH SOME PLANTS

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Dedicated

To

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Certificate

This is to certify that the dissertation entitled "***Studies on foliicolous fungi associated with some plants***" submitted to the Department of Botany, Aligarh Muslim University, Aligarh in the partial fulfillment of the requirements for the award of the degree of Master of Philosophy (Plant pathology), is a bonafide work carried out by Mr. Athar Ali Ganie under my supervision.

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Introduction

Introduction

Fungi are eukaryotic, spore producing, achlorophyllous organisms with absorptive nutrition that generally reproduce both sexually and asexually and whose usually filamentous branched, somatic structures known as hyphae, typically are surrounded by cell wall. Fungi represent an essential component of biodiversity, not only because of the large number of species, but also for their ecological, evolutionary and socio-economic significance. Yet, until recently, fungi received scant consideration. Their under-representation is largely the result of a lack of scientific knowledge of fungal biodiversity. We know more about large, economicaly important plants and animals than we do about fungi, despite being more diverse. Each year, hundreds of fungal species are being lost even before they are known to the scientific world. With the loss of each species, we lose its potential source. Fungi differ in their morphology, ecology, life history strategies, etc. The extent of fungal diversity is so high that, it is very difficult to have expertise in all the fungal groups.

Defining the number of fungi on earth has always been a point of confusion (Fries 1825, Bisby and Ainsworth 1943), but has gained prominence in scientific literature towards the latter part of the twentieth century. While this exercise might on the surface appear to be of peripheral importance, it is fundamental to understanding and protecting the world's mycological diversity. Thus, number of studies has in recent years focused on enumerating the world's

fungal biodiversity (Pirozynski, 1972; Pascoe, 1990; Hawksworth, 1991; Dreyfuss and Chapela, 1994; Rossman, 1994; Hyde, 1996; Hyde, 1997; Hawksworth, 1998; Frohlich and Hyde, 1999; Hawksworth, 2001 and 2004). They have provided the foundation for studies aimed at a better understanding of fungal biodiversity worldwide, and results have been used to motivate for bioconservation and fungal biodiversity studies.

It is widely recognised that fungi have been relatively poorly collected and studied from most countries, regions and habitats. This is at least in comparison to plants and animals that are considerably easier to collect and identify than fungi. One might then have expected that the predicted numbers of fungi on earth would have been considerably greater than 1.5m as suggested by Hawksworth (1991). Clearly different authors that have considered the likely total number of fungi have had differing views of an appropriate answer, but the discrepancy between the results of most of these studies is not particularly great. It is currently accepted that the 1.5m estimate is highly conservative. The 100,000 species of fungi that have thus far been described, therefore represents no more than 7 % of the estimated total.

Table 1: The number of fungi described (modified from Hawksworth *et al.*, 1995).

Kingdom	Phylum	Species
1. Protozoa	1. Acrasiomycota	**12**
	2. Dictyosteliomycota	**46**
	3. Plasmodiophoromycota	**719**
		812
2. Chromista	1. Hyphochytriomycota	**24**
	2. labyrinthulomyxota	**42**
	3. Oomycota	**694**
		760
3. Higher Fungi	1. Ascomycota	**32,267**
	2. Basidiomycota	**22,244**
	3. Chytridiomycota	**793**
	4. Zygomycota	**1056**
	5. Mitosporic fungi	**70,464**
Total		**72,036**

The foliicolous fungi or leaf fungi mainly include black mildews, rusts, smuts, powdery mildews, downy mildews and sooty moulds. Taxonomically, black mildews belong to several taxonomic groups such as Hyphomycetes, *Meliolales, Schiffnerula* and its anamorphic forms, *Asterinales, Meliolinaceae*, etc. In contrast to powdery mildews, black or dark mildews are obligate ecto-parasites producing black colonies on the surface of the host plants. The present study entitled "*studies on foliicolous fungi associated with some plants*" was undertaken with the main aim of isolating, culturing and identification of foliicolous fungi or leaf fungi causing considerable damage to crops of economic importance.

Review of Literature

Review of Literature

The foliicolous fungi or leaf fungi such as black and brown mildew, powdery mildew, smuts and rusts are known to attack all kinds of flora. A detailed review on foliicolous fungi from time to time on many plants is as under:

Farr (1983) revised the genus *Asterinema* to include only the type species, *A. casearíae*, and a newly described variety, *A. casearíae* var. amazonensis. It was also revealed by Farr (1983) that *Asterinema glabratum* is reduced to synonym under *A. casearíae*, *A. glabratum* var. *roupalae* is recognized as *Calothyriopsis roupalae*, as recombined by Arx; *A. jahnii* is reduced to synonym under *Echidnodella miconiae* and *A. philippinense* is regarded as a nomen confusum. *Eriothyrium miconiae* is newly described as the anamorph of *Echidnodella miconiae*.

On the basis of morphological characteristics Srivastava and Lal (1984) identified foliicolous fungi, *Botryodiplodia jaczevskii* causing leaf spot disease of rose (*Rosa indica* L.) in the gardens of Allahabad and adjacent areas in India. Pathogenicity tests were conducted with the fungus and Koch's postulates were fully satisfied. In another study, Farr (1986) described and illustrated *Hansfordiopeltopsisis* as a new genus and *H. amazonensis, Asterostomella dilleniicola, Elachopeltella rubescens, Elachopeltis intermedia, Hymeniopeltis major, Manginella oblongispora, Merismella amazonensis, Mycousteria*

ellipsoideispora, Plectopycnis apocynacearum, Plenotrichaius densus, and *P. laxus* as new species. *Usteria morulinae* was renamed as *Mycousteria morulinae. Eriothyriumm iconiae* was transferred to *Elachopeltis* from Amazonia.

Seven species of foliicolous ascomycetes fungi were described by Patel and Pawar (1986) from Western Ghats. These are, viz. *Nematostigma obducens* Syd., *Ophiodothella fici* Bessey, *Phyllachora bourreria., P. spicatie* sp. nov., *P. vitis* sp. nov., *Polystigma astragali* and *Comoclathrix indica* sp. nov. Out of these seven species, three are new sppecies and four are new records from India.

Farr (1987) described and discussed ten new species and three new varieties and one new combination from Brazilian Amazonia. The new species are*: Asteridiella euphorbiacearum, Meliola brevispora, M. chrysobalanacearum, M. torulosispora, Lasiostemma minutum, Vizella amazonica, Asterinal aevipodia, A . stipitipodia, leptophyma grandispora,* and *Asterostomellas tipitipodia. Asterostomellas tipitipodia* were considered anamorph of *Asterina stipitipodia.* The new varieties were: *Asteridiellac hardoniana* Hansf. var. *magnispora, Meliola caesalpiniae* (Hansf and Deighton) Hansf. and Deighton var. *bauhiniae,* and *Viegasia costaricensis* (Sydow) Bat. and Vital var. *effusa. Microthyriella chandler* Hansf. was recombined as *Mycerema chandler* (Hansf.) Farr.

Four *Cercospora* taxa were described, illustrated and reassessed BY Sutton and Hodges (1990) from conifers in relation to their generic placements.

Cercospora sequoiae and *C. juniperina* were referred to *Asperisporium* and *C. exosporioides* and *C. sequoiae* var. juniperi to *Pseudocercospora. Anaphysmene cupressi* sp. nov. was illustrated and described by Sutton and Hodge (1990) from needles of *Cupressus lusitanica* from Guatemala and characterized by semi-immersed to superficial sporodochial conidiomata and hyaline, cylindrical, 10-14-septate, guttulate conidia.

Patil and Sawant (1991) studied and described eight hyphomycetous species from southern parts of the country. These are *Cercospora arthraxonis* sp. nov., *C. coicis* sp. nov., *Cercosporidium vitis* sp. nov., *Sporidesmium litseae sp. nov., Stenella ceropegiae* sp. nov., *Trochophora simplex (*Petch) R. T. Moore, *Xenosporium africanum* Piroxynski and *Zygosporium majus* Pirozynski.

Khan *et al* (1991) described and illustrated *Pseudocerc- ospora myricacearum* sp. nov. *Euonymis echinatus*-Myricaceae), *Spiropes stranvaesiae* sp. nov. on *Stravaesia glaucescens* - Rosaceae, *Stenella prinsepiae* sp. nov. on *Prinsepia utilis* - Rosaceae and *Verrucispora luculiae* sp. nov. on *Luculia gratissima* - Rubiaceae) from Kathmandu valley of Nepal.

Verma and Kamal (1991) described and illustrated three species of *Pseudocercospora,* viz., *P. asteracearum* on leaves of *Blumea oxyodonta* and *Ageratum oonzyoides, P. moracearum* on *Morus serrata* Roxb. and *P. rungiae* on

Rungia parviflora Nees and *Ruella prostrata* Poir. from Nainital and Ranikhet (Utter Pradesh).

Ten foliicolous fungi were described and illustrated by Crous (1993). With the exception of *Chaetospermum chaetosp- orum* Smith and Ramsb., nine fungi were new records for south Africa, namely *Dictyosporium elegans Corda*, *Helicosporium phragmites* Honel, *Mycotribulus mirabilus* Nag Raj and Kendrick, *Pestalosphaeria hensenii* Shoemaker and Simpson and its *Pestalotiopsis*, *Phacidium eucalypti* Beatson and Weste and its anamorph *Ceuthospora Massee, Phyllosticta eucalaptorum* Crous, Wingfield, Ferreira and Alfenas, *Pseudocercospora handelii* (Bubak) Deighton, *Selenordriella fertilis* (Pirozynski and Hodges) Castaneda Ruis and Kendrick, and *Semifissispora rotundra* Swart. Furthermore, two telomorphs were described as *Phyllosticta eucalyptorum* and *P. cussoniae* Cejp as *Guignardia eucalyptorum* Crous sp. nov. and *G. cussoniae* Crous sp. nov.

Crous and Swart (1993) presented new records of foliicolous fungi on leaves of *Eucalyptus* from Madagascar. The known foliar pathogens such *as Aulographina eucalypti, Cylindrocladium quinquesseptatum, Kirromyces epicoccoides, Pseudocercospora eucalyptorum, Harknessia hawaiiensis and Mycosphaerella heimii* were found associated with leaf spots. *Cordinea eucalypti, C. septata, Arnaudiella eucalyptorum, Mycotribulus mirabilus, Clyeophysallospora latitans, Glomerella cingulata, Cylindrocladium candelabrum*

and *Propolis emarginata* were isolated from *Eucalyptus* leaf. Previous studies have also shown all these fungi present in South Africa, *except C. quinueseptatum,* which were not known from Africa and *M. heimii* which was known only from Madagascar. *M. heimii* is distinguished from similar *Mycosphaerella species* occuring on *Eucalyptus* leaves by its symptom expression, ascospore morphology and cultural charecteristics.

Crous *et al* (1994) recorded several leaf pathogens associated with Proteaceae cultivated in Australia. These include *Botryosphaeria proteae*, *Coleroa senniana*, *Kabatiella proteae*, *Mycosphaerella jonkershoekensis* and *Mycosphaerella lateralis*. The host range of *Phyllosticta telopea* was expanded to also include *Grevillea*, *Leucadendron* and *Leucospermum*, and a *Pestalotiopsis* leaf spot known previously from Africa only was also reported on *Protea* and *Telopea* by Crous and Swart (1994).

Hudhes and Pirozyns (1994) illustrated *Endomeliola dingleyae*, a new genus and new species of Meliolaceae on *Coprosma,* with the unusual feature of immersed foliicolous hyphae bearing hyphopodia. Immersed hyphae emerge via stomata and form a coalescent crust which bears phialides and separate ascomata or ascomatous locules in pulvinate stromata.

Morris and Corus (1994) described and illustrated ten foliiclous cercosporoid fungi from different exotic weeds of South Africa. Seven of these were new records for South Africa, namely *Cercospora brachiat* Ellis and

Everhart, *C. echii* Winter, *C. physalides* Ellis, *C. piatiae* Naj Raj (Govind and Thirumalachar), *C. plantagenis* Sacc, *Mycovellosiella capsellae* (Ellis and Everhart) Deighton which was known from *Brassica* species such as *Raphanus raphanistrum* L. *Mycovellosirlla lantaniphila* acarous and Morris sp. nov. was described as new from *Lantana camera* L. and *Cercospora avicularis* was reallocated to *Passalora* as *Passalora avicularis* (Winter) Crous. U. Braun and Morris comb. nov.

Hudge (1995) described and illustrated the holotype of the type species of *Pauahia,* the foliicolous *P. sideroxyli* from Hawaiian Island. In another study, Petrak (1995) viewed that this fungus is a "Meliolineae" confirmed by the detection of additional features, including stalked hyphopodia, phialides, neck cells with distally thickened laminated walls in and around ostioles, and curved three-septate ascospores which germinate unilaterally from thinner-walled zones of their flattened to concave surface.

Several foliicolous fungi such as *Aulographina eucaltpti, Ceuthospora innumera, Fairmaniella leprosa* were collected by Wingfeild *et al* (1995). In addition, they reported two distinct species of *Mycosphaerella, M. swartii, M. cryptica* and their respective anamorphs *Sonderhenia eucalypticola* and *Colletogloeum nubilosum* from Eucalyptus leaves of Chile South Africa.

Two interesting leaf spotting fungi viz; *Tripospermum fici* sp. nov. on *Ficus sp.* and *T. lamiacearum* sp. nov. on *Colegrookia oppositifolia* Smith were

described and illustrated by Sharma *et al* (1995) from forest sites of Amarkantak (M.P) by comparing with allied species. Sutton *et al* (1996) introduced name *Quasiphloeospora*, with type sp*ecies Q. saximontanensis* for a species associated with foliar lesions on the forest weed, *Ribes viscosissmum* and other species of *Ribes* from U.K, Canada and South Africa. It was compared with similar genera and spp. of hyphomycetes and coelomycetes larger, especially *Phloerospora ribis* comb. nov. Which with it has been confused.

Crous *et al* (1997) described new sp. of hyphomycetous fungi *Falcocladium sphaeropeunculatum* Crous and *Alfenas* sp. nov. on leaves of *E. pellita* Muell. and *Brassiana* Blake from amazonas province of Brazil. A new apecies *Asterostomella dilleniacearum* key to the species of the genera *Asterina* and *Asterostomella* infecting members of the family Dilleniaceae was proposed by Hosagoudar and Abraham (1997).

Three new species of *Corynespora* viz., *C. cucurbitaecola* sp. nov. *C. jasminicola* sp. nov. and *C. trictioides* sp. nov have been collected by Meenu *et al* (1998) from living leaves of *Coccinia grandis* L. (*Cucurbitaceae), Jasminum arborescens* Roxb. (Oleaceae) and *Triumfetta rhomboidea* Jacq. (Teliaceae) respectivily in the forest flora of Nepal. Sharma *et al* (1998) described and illustrated three species of *Cladosporium, viz. C. glochidionis, C. malvacearum and C. kapildharens* causing leaf spot disease on various Angiospermic flora, viz

Glochidion sp. (Euphorbiaceae), *Kydiae calycinae* Roxb. (Malvaceae) and *Hospitis ignoti* Janurio from the forest flora of Nepal Himalayas.

Hosagoudar *et al* (1999) described and illustrated two *Meliola* species, *Asteridiella millettiae* and *Meliola desmodii-pulchelli* from Thiruvananthapuram, Kerala. In another study, Hosagoudar *et al* (1999) collected foliicolous fungi from Kerala state. Of these, *Asterina xanthophylli* and *Phyllachora keralica* are the new species, *Schiffnerula camelliae* is reported here for the first time from southern India.

Giuseppe *et al* (1999) assessed occurance of phylloplane fungi from herbaceous plants endemic to native Kenya grassland in the Marula Estate using leaf cultures on tap water Agar. From 26 samples, 261 fungal isolates representative of 58 genera and 92 taxa were identified. The principle filamentous fungi were of genera, *Alternata, Bipolaris, Curvularia, Epicoccum, Fusarium, Nigrospora, Periconia* and *Pithomyces.* The fungal species that occurred most frequently were: *Alternaria alternata aggreate* (73%), *Pithomyces chartorum* (73%), *Nigrospora sphaerica* (42%), *Torula herbarum (30%)* and *Microsphaeropsis olivarea* (27%). Fungi of limited occurance were: Didymorphaeria oblitescens, *Doliomyces mysoriensis, Endophragmella dimorphospora, Parapericonia angusii, Podospora mimicandata, Spedazzinia tessartha, Sporomiella minima, Stagonospora vitensis, Stigmella effigurata, Truncatella conorum.* In another study, eight species of *Phyllachora* occurring on

the pantropical plant family from Australia were described by Pearce *et al* (1999). Of these five taxa viz: *Phyllachora trivialis, P. metastelmatis, P. gloriana, P. discltidiae, P. ajrakarii* are untenable. In addition, *Phyllachora gloriana* sp. nov. on *Tylophora benthamii* in North Queensland and Australia is also described by (Pearce *et al.*, 1999). Based on morphological characters, Arun arya *et al* (1999) reported a new species of *Phomopsis, Phomopsis tamarindii* causing a severe leaf spot disease of tamarind, *Tamarindus indica* from Baroda, Allahabad.

Saenz and Taylor (1999) infered phylogenetic relationships of two *Meliola* species, one *Meliolina* species, and 36 other ascomycetes from sequences of the nuclear small subunit ribosomal RNA gene. Phylogenetic analyses revealed that the Meliolaceae are members of the unitunicate Pyrenomycetes, and are not closely related to the bitunicate ascomycetes. The Meliolaceae have been hypothesised to be closely related to the Erysiphaceae, but the cladistic analyses showed that the two families are not closely related. The phylogenetic position of *Meliolina* is found amongst the bitunicate ascomycetes making it distantly related to the Meliolaceae. In another study, Braun and Sivapalan (1999) summerised the distribution and host range data of *Cercospora-like* hyphomycetes from Brunei Darussalam. *Pseudocercospora bruneiensis* sp. novo on *Aglaonema* sp., *P. jasminicola* var. *effusa* var. novo on *Jasminum sambac, P. pangiicola* sp. novo on *Pangium edule,* and *Stenella orchidacearum* sp. novo on *Vanda* sp. were described, and the new combinations *Passalora caladii, Pseudocercospora*

caseariae, and *P. thunbergiae* were introduced. *Cercoseptoria caseariae* was reduced to synonym with *Pseudocercospora samydacearum.*

Crous *et al* (2000) described new *Mycosphaerella* teleo- morph states for *Nothostrasseria dendritica* and *Trimmatostroma excentrica.* They introduced two new hyphomycete genera. Of these, *Cibiessia* gen. nov., with three new species accommodates an arthoconidial synanamorph of *Readeriella. Phaeothecoidea* gen. nov. was described for species with brown, thick-walled endoconidia. Four additional new species of *Mycosphaerella* were introduced with several new anamorph species described in *Dissoconium, Phaeophleospora, Pseudocercospora, Ramularia* and *Stenella.* Furthermore, an epitype was designated for *Mycosphaerella molleriana.* Crous *et al* (2000) also presents new *Eucalyptus* host and distribution records including *M. mexicana* from Hawaii, *M. ohnowa* from Australia, *M. acaciigena* from Australia and Venezuela, *M. heimii* from Venezuela and Thailand, *M. konae* from Venezuela, and *M. thailandica* from Thailand.

Four new species of *Asterina* were reported by Hosagander (2000) from Kerala. *Asterina adeniicola* sp. nov differs from its allied species *A. adenie* in having opposite appresoria and shorter ascospores; *Asterina girardiniae* sp. nov. differs from its allied spp. in having 10% opposite appressoria; *Asterina sacardrae* sp. nov. differs from *A. chloranthi* in having very thin hypophyllus colonies; *Sarcinella glochidi* sp. nov. was proposed here as a new species and it was known

for the first time on the host genus *Glochidion. Asterina diplocarpa* and *Sarcinella raimundi* were therefore considered as new records from India.

While working on leaf fungi, four species of *Meliolaceae* have been reported by Hosagoudar *et al* (2000) from Kerala, India. Of these, *Irenopsis vaccinii, Meliola cholakadensis* and *M. mannavanensis* are new species, while *Meliola oldenlandiae* Hansf. and Stev. were reported herein for the first time from India. Bhartiya *et al* (2000) while comparing with other morphologically similar taxa, collected three new species of *Cercospora* Fres. viz. *C. capsicigena, C. lycopersicicola* and *C. solanigena* on *Capsicum annuum, Lycopersicon esculentum* and *Solanum melongena,* respectivily, from vegetable fields in Gorakhpur, Kushinagar districts of North Eastern Uttar Pradesh. Four new species of *Pseudocercospora* viz. *P. cassiaesophorae, P. cocculicola, P. eucalypticola and P. kolanensis* have been described and illustrated by Singh *et al* (2000) occuring on leaves of *Cassia sophora, Cocculus hirsutus, Eucalyptus sp. and Woodfordia* sp. respectivily from Mirzapur, Uttar Pradesh.

Hosagoudar *et al* (2001) collected foliicolous micromycetes from Peppara and Neyyar wildlife sanctuaries and Munnar and Wyanad Hill Shoal forest of Kerala. Of these fungi *Asterina cryptocariicola, A. morellae, A. neolitsiicola, A. pongalaparensis* are new species. Likewise, a new species of *Asterina, Asterina arecacearum* have been described on leaves of *Calamus* sp. in the Montane forests of South India by Hosagoudar *et al* (2001). Chaudhary *et al*

(2001) described and illustrated four new species of the form genus *Stenella viz. S. bischofiae-javanicae, S. browniaeicola, S. caryotae-urensis* and *S. millettiae* occuring on living leaves of *Bischofia javanica, Brownea hybrida, Caryota urens* and *Millettia ovalifolia* respectivily in the forest flora of North Eastern Uttar Pradesh.

Six new species of *Cercospora* viz. *C. bixaecola* sp. nov. on living leaves of *Bixa orellena* L. (Bixaceae), *C. calendulaecola* sp. nov. on *Calendula* sp. (Asteraceae), *C. gossypiicola* sp. nov. on *Gossypium hirsutum* L. (Malvaceae), *C. hibicina* sp. nov on *Hibiscus subdarifola* L. (Malvaceae), *C. jasminae* sp. nov. on *Jasminum multiflorum* (Oleaceae) and *C. tephrosiicola* sp. nov. on *Tephrosa purpurea* Pers. (Fabaceae) respectivily have been reported by Narayan *et al* (2001) from Teria belts of India.

Sivanedan and Shivas (2002) described and illustrated *Lembosia araucariae* sp. nov., *Lembosia syzygii* sp. nov., *Lembosina alyxiae* sp. nov., *Lembosina diospyrosi* sp. novo and *Lembosina eucalypti* sp. novo on leaves of *Araucaria, Syzygium, Alyxia, Diospyros* and *Eucalyptus* respectively from Australia. *Lembosia hosagoudari* nom. novo was proposed to accommodate *Lembosia syzygiicola* Hosag., which was a later considered homonym of *Lembosia syzygiicola* (Hansf.) Deighton.

Four new species of foliicolous Loculoascomycetes, viz. *Didymella melaleucae* sp. nov., *Rosenscheldiella dysoxyli* sp. nov., *Seynesiella melaleucae*

sp. novo and S. *syzygii* sp. nov. on *Dysoxylum, Melaleuca* and *Syzygium* respectivily were reported by Sivanesan and Shivas (2002) from Queenland Australia. The hosts are indicated by the specific epithet. Four *Discostromopsis* species have been redisposed to *Discostroma* as *Discostroma callistemonis* (HJ. Swart) Sivan. comb. nov., *D. elegans* (HJ. Swart) Sivan. comb. nov., *D. leptospermi* (HJ. Swart) Sivan. comb. novo and *D. stoneae* (HJ. Swart) Sivan. comb. nov. by Sivanesan and Shivas (2002).

Sivanesan and Shivas (2002) also reported two new species of *Phyllachora.* One on leaves of *Neoitsea dealbata* which has been described as a new species of *Phyllachora.*The other on the leaves of *Eucalyptus* species has been known as new species of *Brobdingnagia,* another member of the *Phyllachoraceae.* Currently eight genera of *Phyllachoraceae,* namely *Coccodiella, Glomerella, Ophiodothella, Parberya, Phyllachora, Polystigma, Rehmiodothis* and *Sphaerodothella* are known in Australia (Pearce and Hyde, 2001).

Based on detailed morphotaxanomic investigations of phytoparasitc fungi of forests and cultivated plants of Madhya Pradesh, Jain *et al* (2002) revealed three hitherto undescribed species of *Corynespora* viz. *C. bombacearum* on *Bombax malabaricum* DC. (Bombaceae), *C. holopelea* on *Holoptelea integrifolia* Linn. (Ulmaceae) and *C. zizyphae* on *Zizyphus grialdi* (Rhamnaceae).

Chaudhary *et al* (2002) decribed three new species of *Stenella,* viz *S. lamiacearum, S. polyalthiae* and *S. rubiacearum* on living leaves of *Teucrinum*

sp., *Polyalthia suberosa* and *Wendlandia trictoria* respectivily from North Eastern Uttar Pradesh. In another study, three new species of *Corynospora,* viz. *C. trematicola, C. solanii* and *C. viticola* on leaves of *Trema orientalis* (Ulmaceae), *Solanum indicum* (Solanaceae) and *Cayratia carnosa* respectivily were revealed by Sharma *et al* (2002) from Terai belts of North Eastern Uttar Pradesh.

Hosagoudar (2003) described in detail with geographic distribution of eleven species of genus *Meliola* on eight rare medicinal plants of southern India. Of these *Meliola ardigoosii, M. benosensis var puerariicla, M. buchananiicola, M. kingiodendri* and *M. thitei* are endemic fungi. In another study, Hosagoudar *et al* (2003) described and illustrated four new *Asterina* species from Yunnan such as *Asterina flacourtiaceicola* on *Flacourtiaceae* indet., *Asterina horsfieldiicola* on *Horsfieldia glabra* (Myristicaceae), *Asterina phoebicola* on *Phoeba lanceolata* (Laueaceae), and *Asterina stixis* on *Stixis suaveolens* (Capparidaceae).

Denise and Dianese (2003) described new hyphomycetes in association with leaves of native plants of the family Vochysiaceae (Rutales), from Brazilian Cerrado. Of these six species are new belonging to genera *Alternaria* (*A. qualeae* sp. nov.), *Janetia* (*J. salvertiae* sp. nov.), *Passalora* (*P. qualeae* sp. nov.) and *Periconiella* (*P. longispora* sp. nov., *P. qualeae-grandiflorae* sp. nov. and *P. campo-grandensis* sp. nov.).

A hyphomycete *Cladosporium chlorocephalum* (*C. paeoniae*) causing leaf blotch symptoms on *Poenia* species were reported by Schubert *et al* (2003). On the basis of observations in culture, supported by DNA sequence data from the ITS and LSU gene regions they proposed the cospecificity of two morphs on living leaves of *Paeonia* spp. Sequence data were identical, indicating a single species with two morphs. On account of its distinct conidiogenous loci and conidial hila, as well as its sequence-based phylogenetic position they were separated from the *Davidiella/Cladosporium* clade and the Peony fungus has been excluded from *Cladosporium*, but were still placed in *Davidiellaceae* (*Capnodiales*). It was further revealed by Schubert *et al* (2003) that the leaf blotching (cladosporioid) morph of this fungus morphologically resembles species of *Fusicladium*, but differs in having dimorphic fruiting and is phylogenetically distant from the *Venturiaceae*. The macronematous (periconoid) morph resembles *Metulocladosporiella (Chaetothyriales*), but lacks rhizoid conidiophore hyphae and has 0-5 septate conidia. Hence, *C. chlorocephalum* was assigned to the new genus *Dichocladosporium* (Schubert *et al* 2003).

Forty six isolates of *Botryosphaeria* have been reported by Crous *et al* (2003) from proteaceous hosts growing in various parts of the world, using morphology, cultural characters and sequence data from the ITS region of the rDNA operon. It was further observed by Crous *et al* (2003) that five *Botryosphaeria* species were found to be associated with Proteaceae.

Botryosphaeria lutea was isolated from *Banksia* and *Buckinghamia* spp. in Australia, and a single isolate was obtained from *Protea cynaroides* in South Africa. *Botryosphaeria proteae* was found associated only with South African Proteaceae, but also occurred in many parts of the world. Another *Botryosphaeria* sp. that occurred exclusively on South African Proteaceae represents a new taxon that was described as *B. protearum*. This pathogen was found on South African Proteaceae cultivated in Australia, Hawaii; Portugal, including the Madeira Islands; and South Africa. *Botryosphaeria ribis* was found associated with both South African and Australian Proteaceae (Crous *et al* 2003).

Bhartiya *et al* (2003) based on critical examination and comparision with allied taxa, reported four new species of *Cercospora* viz., *C. atylosegena, C. celosiicola, C. moghamicola* and *C. pouzolziicola* occuring on leaves of *Atylisia* sp., *Celosia coronate, Moghamia prostrata* and *Pouzolzia indica* respectivily. Hosagoudar and Agarwal (2003) described and illustrated four species of foliicolous fungi, *Asterina aporusae, A. atalantiae, A. malloticola* and *Teratosperma anacardii* on the leaves of *Aporusa lindleyana* (Euphobiaceae), *Atalantia rotundifolia* (Rutaceae), *Mallotus philippensis* (Euphorbiaceae) and *Dalbergia sissoides* (Fabaceae) respectivily from Kerala. Hosagoudar (2003) recorded 87 fungal species from Coorg district of Karnataka. Of these, 14 are new species *Asterigiella acanthacearum, A. capparidigena, Asterina aglaiae, A. canthii-dicocci, A. hyltidicola, A. madikeriensis, A. parsonsiae, A. talacouverina,*

Asterliberta vateriae, Asterostomella elaeocarpiserrati, Meliola parsonsiicola, Sarcinella pouzolziae, S. allophyli and *Shiffnerula glochidii. Asterina piperina* Sydow, *Schiffnerul pulchra* (Sacc) Petrack and *S. ricini* Hansf. were new records from India. while, *Armatella cinnamomi* Hansf and Thirum was relocated after the lapse of half a century.

Several new foliicolous plant pathogens including *Pseudocercospora beilschmiediae*, *P. coprosmae*, *P. dianellae*, *P. libertiae*, *P. oleariae*, *P. pomaderridis*, *Pseudocercosporella helenii*, *Ramularia coprosmae* and *Stenella aucklandica* were described by Braun and Dick (2004), from New Zealand and the new combination *Pseudocercospora nogalesii* was introduced. Furthermore, some additional cercosporoid leaf spot diseases that are new to New Zealand were recorded. The taxonomy of *Cercospora* on *Limonium* spp. showed that two species are involved, viz. *Cercospora apii* slat. (*C. statices* Pesante) and *C. insulana* (*C. statices* Lobik). (Braun *et al* (2004).

A new parasitic fungus and a new hyperbiotrophic fungus was reported by Young-mee and Crane (2004) on the leaves of the subtropical plant, *Tetrazygia bicolor* (Mill.) Cogn., from Florida, USA. The parasitic fungus was placed in the genus *Asterina* as a new species, *Asterina tetrazygiicola* Ahn and Crane, sp. nov. The hyperbiotrophic fungus on *A. tetrazygiicola* was assigned to the genus *Phaeodimeriella* as *Phaeodimeriella asterinae* Ahn and Crane sp. nov. Both fungi are described, illustrated, and typified by Young-mee and Crane (2004). A

previously described species, *Asterina tetrazygiae* Ryan, living on *Tetrazygia elaeagnoides* (Sw.) DC., was redescribed, illustrated, and lectotypified from the original Puerto Rican material by Young-mee and Crane (2004).

Dornelo and Dianesel (2004) described three new hyphomycetes in association with trichomes on the leaves of native species of *Qualea* (Vochysiaceae) from the Brazilian Cerrado. These are: *Trichomatomyces* gen. nov. (type species: *T. byrsonimae* comb. nov.), *Trichosporo-dochium* gen. nov. (type species: *T cerradensis* sp. nov.), and *Phaeoidiomyces* gen. nov. (type species: *P. qualeae*). A foliicolous fungus *Bellulicauda dialii* (Sydow) Sutton, attacking leaves of *D. angolense* Oliver and *D. guineense* Willd was reported by Pereira *et al* (2004) from Sierra Leone (Africa). The genus *Bellulicauda* Sutton was based on *Diachorella dialii* Sydow, and then excluded from the genus *Diachorella* (Sutton, 1967). The genus is considered still monotypic (Nag Raj 1993).

Gawande *et al* (2004) described five new species and three new varieties of foliicolous ascomycetes from various localities of Northera India. These are *Asterina lawsonii* on *Lawsonia alba* L., *Meliola dehradunensis* on *Alstonia scholaris* R. Br., *M. capensis* (Kalch and Cooke) var. *dimocarpi* var.nov. on *Dimocarpus longon* L., *M. desmodii triangularis* on *Desmodium triangularae* (Retz.) Merr., *M. desmodii triquetri* on *D. triquetrum* DC., *M. panici* Earle. var. *vetivericola* var. nov. on *Vetiveria zizanoides* (L.) Nash, *M. strychnii-nuxvomicae*

on *Strychonus nux-vomica* and *Pleospora vagans* var. *aconitii* var. nov. on *Aconitum* species.

Ten new Meliolaceous fungi have been described and illustrated by Hosagoudar (2004) from Western Ghat of Kerala. These are *Asteridiella justiciae* on *Justicia* sp., *Meliola ardisiicola* on *Ardisia misions* Wall., *M. cannanicola* on *Toddalia asiatica* (L.) Lam., *M. chassaliicola* on *Chassalia* sp., *M. desmodii-velutina* on *Desmodium velutinum* (Willd) DC., *M. erythroxylicola* on *Erythroxylum monogynum* Roxb., *M. urariae* on *Uraria rufescens* (DC.) Schindl., *M. pseudarthriae* on *Pseudarthria viscinda* (L.) Wright & Arn., *M. strychnigena* on *Strychnos* sp. and *M. tylophorae-indicae* on *Tylophora indica* (Burm.) Merr.

Jain and Rai (2004) reported three new spp. of *Alternaria* viz., *A. aracearum* on *Raphidophora pertusa* Scht. (Asteraceae), *A. bundelkhandae* on *Leucaena leucocephala* Dewit. (Mimosaceae) and *Cryptostigia grandiflora* R. Br. (Asclepiadaceae) from forest flora of Madhya Pradesh.

Verkley *et al* (2004) presented phylogenetic relationships of 17 selected *Septoria* spp. (eight with a known *Mycosphaerella* telomorph), *Phloeospora ulmi* (Telomorph, *M. ulmi*) and 18 additional taxa (10 with *Mycospaerella* telomorph), using ITS and D2-LSU nrDNA. In total, 10 anamorphic genera associated with *Mycosphaerella.* They further found that Interspecific variation in ITS was limited in *Septoria.* The *Septoria tritici* was found closely related to *S. passerini* as found

in ITS analysis clusters with *Ramularia* spp., in the D2 analysis were distinct from the other *Septoria* species. The pathogens *Septoria apiicola, S. linicola* and *S. populiicola* cluster in a major clade containing *M. ulmi* and other *Septoria* spp. and *Cercospoa* spp. Both analysis indicate that *Septoria* was not monophyletic within *Mycospaerella* (Verkley et al 2004).

Gadgil *et al* (2005) described four fungi, either new or have not been fully described from New Zealand. These fungi are: Foliicolous Ascomycota: *Calonectria acicola* sp. nov. and its anamorph *Cylindrocladium acicola* sp. nov. on *Pinus radiata.* Xylophilous anamorphic fungi: Hyphomycetes: *Sporothrix nothofagi* sp. nov. on *Nothofagus fusca.* Corticolous Ascomycota: *Valsaria rubricosa* on *P. radiata.* Radicicolous anamorphic fungi: Hyphomycetes: *Leptographium alethinum* on *P. radiata* and *P. strobus.*

Reynolds and Gilbert (2005) identified epifoliar ascomycete fungi from leaf surfaces in the tropical rain forests of Queensland, Australia and yielded 42 genera and 50 species, including one new genus (*Dubujiana*), three new species (*Dennisiela asetosa, Dubujiana glandulifera, Microxiphium pleomorphum*), three new combinations (*Polychaeton purpuraefaciens, Seuratia australiensis, Stomiopeltis gautheriae*), lectotypification of *Micropeltis biseptata.* Ten taxa of foliicolous fungi were collected and identified from different parts of Kerala by Hosagoudar (2005). Of these, *Asterina cannonii, A. gamsii, A. euryae, A. girardiniae, A. glycosmidis, A. glypcopetali, A. hydrocotyles, A. plectranthi, A.*

toxocarpi, Echidnodella manilkarae, Questioriolia passiflorae and *Q. saracococcae* are the new species. *Asterina jasmine* Hansf. Var. *Indica* forms a new variety. *Lambosia perseae* was reported for the first time from India.

Jana *et al* (2005) described two leaf inhabiting species of *Meliola,* collected from Nagaland, viz *M. holarrhenae-pubescens* and *M. gymnemae* on *Holarrhena pubescens* (Buch-Ham.) Wallich ex G. Don. and *Gymnema* species. Braun *et al* (2006) described new species of biotrophic fungi on leaves of various hosts such as *Cladosporium arthropodii, C. oncobae, Distocercospora livistonae, Pseudo-cercospora arecacearum, P. gunnerae, P. pandoreae, Ramularia subtilis, R. tenella and Stenella anthuriicola Arthropodium cirratum, Oncoba spinos, Livistona chinensis, Rhopalostylis sapida, Gunnera tinctoria, Pandorea pandorana, Ligularia clivorum, Lupinus polyphyllus* and *Anthurium* sp. respectivily. In addition, some other biotrophic fungi are recorded from Australia, Fiji and New Zealand for the first time (Braun *et al* 2005). *Cladosporium idesiae* was reduced to synonym with *C. herbarum var. macrocarpum.*

Hudge and Crane (2006) described and illustrated *Torula glutinosa* parasitic on leaves of *Eriodictyon* spp. From california. it shares with the type species of *Heteroconium, H. citharixyli*, acropetical conidiogenesis of chains of conidia of variable length and acropetical transseptation. Hunter *et al* (2006) identified approximately 60 *Mycosphaerella* spp. from various *Eucalyptus* spp. causing leaf diseases collectively known as Mycosphaerella Leaf Disease (MLD)

in Netherland. These species were distinguished on the basis of DNA sequence analysis of *Mycosphaerella*. Sequences of the Internal Transcribed Spacer (ITS) region of the ribosomal RNA operon, Elongation factor 1-alpha (EF-1α) and Actin (ACT) have most commenly been used by Hunter *et al* (2006) to reconsider species boundaries for *Mycosphaerella* spp. from *Eucalyptus*. A further study was carried out by them to study the anamorph concepts and resolve the deeper nodes of *Mycosphaerella*, for which part of the Large Subunit (LSU) of the nuclear rRNA operon was sequenced. The ITS and EF-1α gene regions were found to be useful, but the ACT gene region did not provide species-level resolution in *Mycosphaerella*.

Three new species of *Passalora*, viz *Passalora convoluta*, *Passalora caribensis* and *Passalora chromolaenae* and one species of *Septoria*, *Septoria chromolaenae* and *Pseudocercospora*, *Pseudocercospora eupatoriella* respectively were reported by Breeyen *et al* (2006). Furthermore, *Septoria ekmaniana* and *Passalora perfoliati* were also confirmed from *Chromolaena* during the course of this study on *C. odorata* from South and Central America.

Groenewald *et al* (2006) described numerous species of *Cercospora* from diverse hosts and locations. These species were morphologically indistinguishable from *C. apii* and subsequently were referred to as *C. apii* sensu lato. They showed that Cercospora leaf spot on celery and sugar beet are caused respectively by *C. apii* and *C. beticola* respectivily, both of which are part of the *C. apii* complex.

They also characterized a new *Cercospor*species, *C. apiicola*, which was isolated from celery in Venezuela, Korea and Greece, Groenewald *et al* (2006). The phylogenetic relationship between *C. apiicola* and other closely related *Cercospora* species was studied with five different gene areas. These analysis revealed that the *C. apiicola* isolates cluster together in a well defined clade. Both *C. apii* and *C. beticola* sensu stricto form well defined clades and were shown to have wider host ranges and to represent distinct species.

Based on molecular examination (PCR) as well as reassessment of morphological characters and differences in the conidiogenesis, Braun and Crous (2006), realised that *Mycospaerella Johnson* (Mycospaerellaceae) is one of the largest genera of ascomycetes, produce a wide range of coelomycetous and hyphomycetous anamorphs, including Cercosporoid hyphomy- cetes as largest group. Hofmann and Piepenbring (2006) described and illustrated new records of fungi from Panama on new host plants such as *Asterina sphaerelloides* on *Phoradendron novae-helveticae* and *Morenoina epilobii* on unknown host (Asterinaceae); *Micropeltis lecythisii* on *Chrysophyllum cainito* (Micropeltidaceae); *Schizothyrium rufulum* on *Encyclia* sp. and *Myriangiella roupalae* on *Salacia* sp. (Schizothyriaceae) and *Chaetothyrium vermisporum* and its anamorph *Merismella concinna* on a *Rubiaceae* (Chaetothyriaceae).

Nakashima *et al* (2006) described and illustrated new collections of *Cercospora* species and allied genera from the northern part of Thailand. These

include three new species *Passalora haldiniae*, *Passalora gmeliniicola* and *Pseudocercospora holmskioldiae* as well as 11 records that were new to Thailand. A new genus of the family Meliolaceae, *Ectendomeliola,* type sp. *E. walsurae* were described by Hosagoudar and Agarwal (2006) on the leaves of *Walsuria trifolia* from Sankil forest in Kerala. In another study, Kumar *et al* (2006) explored two new species of hyphomycetes from Varanasi, viz *Cladosporium bauhiniana* on leaves of *Bauhinia variegata* (Caesalpiniaceae), and *Stenella cassinigena* on *Cassia occidentalis* (Caesalpiniaceae) respectivily.

Hosagoudar *et al* (2006) described and illustrated six meliolaceous fungi collected from the Southern Western Ghats of Karnataka. Of these, *Meliola cynanchi* and *M. pterigotae* were the new species. While, *M. desmondii-laxiflori* var. *indica, M. kanniya- kummariana* var. *brahmagiriense* and *M. tabernaemontanae* var. wrightiae are the new varieties. Based on comparission with allied taxa, Kumar *et al* (2006) described a new taxon *Corynecercospoa teraiensis* gen. et sp. nov. from Terai belts of U.P. occuring on the leaves of *Elaeodendron glaucum*. The ectotrophic hyphomycetous fungus produced vegetative appendages with hypopodia, macronematous conidiophores, acropleurogenous conidiogenous cells and enteroblastic, tretic and distoseptate conidia.

Hugde (2007) illustrated and redescribed *Heteroconium citharexyli*, the type species of this genus as a sooty mold bearing acropetal chains of conidia

showing a basifugal sequence of septation. *Heteroconium neriifoliae*, *H. glutinosa* and the *Heteroconium* synanamorph of *Antennulariella concinna* are co- generic. The latter species is neotypified. *Pirozynskiella* new genus, typified by *P. solaninum* comb. nov. (*Helminthosporium solaninum*), differs from *Heteroconium* in having an obligate association with asterinaceous fungi and in the centrifugal sequence of *conidium transseptation* after the initial median septum. A new species of *Stenella* Syd., *S. rubiacearum* was reported by Rai (2007) on living leaves of *Meyna laxiflora* Robyns. (Rubiaceae) from Northern forest division of Gorukhpur.

Kirschner and Chen (2007) described new species of *Cercosporella* parasitic on *Thladiantha punctata* (Cucurbitaceae), *Pseudocercospora* on *Nephrolepis auriculata* (Nephrolepidaceae), and *Stenella* on *Myrsine seguinii* (Myrsinaceae), respectively, from Taiwan. *Periconiella rachidicola* was for the first time recorded from Asia on the new host plant, *Angiopteris lygodiifolia*, *Pseudocercospora sarcocephali* and *Stenella persicae* are new to Taiwan. *Merremia hederacea* was found a new host for *Pseudocercospora timorensis*, and *Ageratum houstonianum* was recorded a new host for *Passalora perfoliati*. *Chromolaena odorata* was also recorded as a new host plant for *Pseudocercospora eupatorii-formosani* in Taiwan.

Several species and genera of ascomycetes were collected by Crous *et al* (2007) from leaves of *Eucalytus spp.* in Australia and South Africa. The new

genera and species included were: *Eucasphaeria capensis* and *Sympoventuria capensis* (Ascomycetes), genera et spp. nov. *Furcaspora eucalypti*, *Harknessia ipereniae*, *H. gibbosa*, *Heteroconium kleinziensis* and *Phacidiella eucalypti*. In another study, Nakashima (2007) described and illustrated new collections of *Cercospora* spp. and allied genera from the Northern parts of Thialand. These include three new species, *Passalora haldiniae, Passalora gmeliniicola* and *Pseudocercospora holmskioldiae.* 11 records *Passalora bougaincilleae, P. mucunicola, P. yiyhoniae, Pseudocercospora bauhiniae, P. buddleiae, P. carbonacea, P. dalbergiae, P. houthuyniae, P. phyllitidis, P. tecomae-heterophyllae, P. viticicola, Cercospora apii,* were also reported from Thialand.

Carnegie *et al* (2007) described four new species of *Mycosphaerella* from *Eucalyptus* spp. as well as other Myrtaceae. *Mycosphaerella tumulosa* sp. nov. (anamorph: *Pseudocercospora* sp.) was found on more than seven species of *Eucalyptus* and *Corymbia* in native forests and plantations in Northeastern New South Wales and Southeastern Queensland and appears to be relatively common, although not damaging to these trees. *Mycosphaerella multiseptata* sp. nov. was also recorded by Carnegie *et al* (2007) from several locations on species of *Angophora* in native forests and amenity plantings and *Mycosphaerella pseudovespa* sp. nov. was found in one location in native forest on *E. biturbinata.* The first species of *Mycosphaerella*, *M. syncarpiae* sp. nov., was also found in native forests in numerous locations from Sydney through to northeastern New

South Wales (Carnegie *et al* 2007). Singh et al (2008) described two interesting and noval species of *Passalora*, viz *P. macarangae* collected on *Macaranga peltata* (Euphorbi- aceae), and *P. peltophori* on *Peltophorum pterocarpum* (Fabaceae) collected from the forests of Western Ghats, India.

Arzanlou *et al* (2008) collected a global set of *Mycosphaerella* strains from banana, and compared them by means of morphology and a multi-gene nucleotide sequence data set. The phylogeny inferred from the ITS region and the combined data set containing partial gene sequences of the actin gene, the small subunit mitochondrial ribosomal DNA and the histone H3 gene revealed a rich diversity of *Mycosphaerella* species on *Musa.* Integration of morphological and molecular data sets confirmed more than 20 species of *Mycosphaerella* (incl. anamorphs) to occur on banana Arzanlou *et al* (2008). This study reconfirmed the previously described presence of *Cercospora apii*, *M. citri* and *M. thailandica*, and also identified *Mycosphaerella communis*, *M. lateralis* and *Passalora loranthi* on this host. Futhermore, eight new species identified from *Musa* were described, viz *Dissoconium musae*, *Mycosphaerella mozambica*, *Pseudocercospora assamensis*, *P. indonesiana*, *P. longispora*, *Stenella musae*, *S. musicola*, and *S. queenslandica.*

In a significant study, Sogonov *et al* (2008) described 22 species of *Gnomoniaceae* leaf-inhabiting genera in the *Gnomoniaceae* using multiple genes, specifically nrLSU, translation elongation factor 1-alpha (tef 1-α), and RNA polymerase II second largest subunit (rpb2) and ITS sequence. These genera and

species were: *Gnomonia incrassata, G. monodii, G. neognomon, G. orcispora, G. pendulorum, G. rodmanii,G. skokomishica, G. virginianae, Gnomoniopsis paraclavulata, Ophiognomonia balsamiferae, O. pseudoclavulata, O. vasiljevae, Plagiostoma barriae.* Some combinations reported were: *Ambarignomonia petiolorum, sApiognomonia hystrix, Gnomonia alnea, G. carpinicola, Gnomoniopsis clavulata, G. comari, G. fructicola, G. macounii, G. racemula, G. tormentillae, Ophiognomonia alni-viridis, O. gei-montani, O. intermedia, O. ischnostyla, O. leptostyla, O. micromegala, O. nana, O. rubi-idaei, O. setacea, O. trientensis; Plagiostoma aesculi, P. amygdalinae, P. robergeanum and P. salicellum.*

About 40 members of *Mycosphaerella* and *Teratosphaeria* (incl. anamorphs) were reported by Crous *et al* (2008) from Proteaceae, using cultures and DNA sequence analysis. They have designated epitypes for several important species, namely *Batcheloromyces leucadendri*, *B. proteae*, *Catenulostroma macowanii*, *Mycosphaerella marksii*, *Teratosphaeria bellula*, *T. jonkershoekensis*, *T. parva*, and *T. proteae-arboreae*. Several species were also newly described, viz *Batcheloromyces sedgefieldii*, *Catenulostroma wingfieldii*, *Dissoconium proteae*, *Teratosphaeria persoonii*, *T. knoxdavesii* and *T. marasasii*. Although accepted as being highly host specific, some species were shown by Crous *et al* (2008) to have wider host ranges, such as *M. communis* (*Eucalyptus*, *Protea*), *M. konae* (*Leucospermum*, *Eucalyptus*), *M. marksii* (*Eucalyptus*, *Leucadendron*), *T.*

associata (*Eucalyptus, Protea*), and *T. parva* (*Eucalyptus*, *Protea*), which in most cases were found to co-occur with other species of *Mycosphaerella* or *Teratosphaeria* on Proteaceae. Furthermore, earlier records of *T. jonkershoekensis* on Proteaceae in Australia were shown to be representative of two recently described species, *T. associata* and *T. maxii.*

Hosagoudar (2008) described and illustrated three foliicolous fungi on *Tabebuia* species. Two were new hyphomycetous anamorphs, *Passalora tabebuiae-ochraceae* sp. nov. and *Pseudocercospora tabebuiae-caraibae* sp. nov. The third was *Elsinoe tecomae*, originally described on *Tabebuia* sp. and were epitypified based on material from *Tabebuia heptaphylla.* Taxonomical novelties include *P. tabebuiae-ochraceae* Inacio and Dianese sp. nov., *P. tabebuiae-caraibae* Inacio and Dianese sp. nov.

Singh *et al* (2008) reported two hitherto undescribed sppecies of *Ramularia* viz., *R. despermae* sp. nov. and *R. euphobiacearum* sp. nov. occuring on *Grewia desperma* Rottl. (Teliaceae) and *Bridelia squamosa* Spreg. (Euphobiaceae) from North-eastern Uttar Pradesh. Singh *et al* (2008) based on morphotaxonomic analysis i.e by comparing with allied taxa, reported hitherto undescribed species of phytopathogenic foliar hyphomycetes viz *Alternaria hydrophila* on *Nymphaea* sp. (Nymphaeceae) ,*Cladosporium spinacearum* sp. nov. on *Spinacea oleracea* (Amaranthaceae) and *Corynespora ehriticola* sp. nov. on *Ehritia laevis* (Ehritiaceae) respectivily, from Terai belts of North-eastern U.P.

In another study, Crous (2008) showed that Australian material of common leaf spot disease occurring on *Eucalyptus cladocalyx* and *E. lehmannii* identified as *C. ovatum* is morphologically and phylogenetically distinct from the South African specimens, and that all these taxa would be better accommodated in the genus *Teratosphaeria*. He further revealed that South African specimens previously identified as *C. ovatum* were found to represent two species that co-occur in the same leaves and even spots and are described here as *T. juvenalis* and *T. verrucosa*. Furthermore, a fresh collection of *T. ovata* from *E. phoenicea* in Australia, was distinguished morphologically and phylogenetically from similar, newly described taxa such as *T. veloci* on *E. miniata*, and *Readeriella dimorpha*, which is also placed in *Teratosphaeria*. Although these leaf pathogens appear to be of minor economic importance, they were found morphologically similar to two serious eucalypt canker pathogens, namely *T. gauchensis* and *T. zuluensis*, which predominantly cause stem cankers, but could also be found occurring in leaf spots on their own (Crous et al 2008).

Sergeeva *et al* (2008) reported *Pseudocercospora cladosporiodes* U. Braun (Syn. *Cercospora cladosporioides, Mycocentrospora cladosporioides*) on the leaves and berries of *Olea europaea* from Australia. Carlos *et al* (2008) found members of Asterinaceae on various host plants. The *Asterina* spp. detected on the leaves of *Salacia crassiflora* (Celastraceae) showing ascomata (44-74×115-226 µm); asci (20-46×11-18 µm) and ascopores (20-30 × 9-12 µm). Another *Asterina*

sp. was associated with *Simaroba versicolar* (Simaroubaceae), charecterised by ascomata (20-62 × 87-200)µm; asci (32-50 × 24-45µm) and ascospores (20-28 × 11-15µm). The only *Asterina* sp. described on Simaroubaceae was *Asterina lobala* Syd and P. Syd that clearly differs from the species found due to its small ascospores (13-18 × 6-7µm), asci (25-35 × 20-25µm) and ascospores (90-125 µm diam).

The four new species of Meliolaceae viz *Meliola aristolochigena, M. pycnospora, M. sairandhriana* and *M. strebli* were reported by Hosagoudar and Archana (2008) on leaves of *Aristolochia tagala* Cham (Aristolochiaceae) , *Pycnospora lutescens* (Poir) Schindl. (Fabiaceae), *Agloia minutiflora* Bedd. (Meliolaceae) and *Streblus taxoides* Kurz. (Moraceae) respectivily from Sairandhri, Salient Valley, Palhat Kerala.

Verma and Kamal (2009) described and illustrated a tar spot fungus, *Paraaoria himalayana* gen. et sp. nov. (Coelomycetes) by comparing with related genera on living leaves of *Citrus* sp. causing hypertrophy of tissues collected from the Kathmandu Valley, Nepal.

Schubert *et al* (2009) described two new species of *Cladosporium* found on needles of *Pinus ponderosa* trees in Patagonia, Argentina, as *C. chubutense* and *C. pini-ponderosae*. An additional isolate from leaves of *Cortaderia* collected in Colombia, which is a sister taxon to the species occurring on *Pinus*, is described as *Cladosporium colombiae*. These species are

phylogenetically closely related, but differ from each other and other known species by multilocus sequence data, phenetic characters and culture characteristics. Using molecular methods based on the ITS1-5.8S-ITS2 cluster, together with morphological characters Marcia and Helena (2009) reported a new *Mycosphaeria sp.*, *Mycosphaerella vespa* causing Mycosphaerella leaf disease (MLD) on *Eucalyptus globulus* in Protugal.

Hosagoudar and Archana (2009) summerised the order Meliolales comprises two families, namely, Armatellaceae and Meliolaceae. Except the genera, *Endomeliola* and *Pauhia*, India represents rest of the nine genera of this group. The family Armatellaceae includes two genera, viz *Armatella* and *Basavamyces*. It was further revealed that the family Meliolaceae includes seven genera: *Amazonia*, *Appendiculella*, *Asteridiella*, *Ectendomeliola*, *Irenopsis*, *Meliola* and *Prataprajella.* All these nine genera represent 613 species and infraspecific taxa known till the year 2006, infected 766 host plants belonging to 349 host genera distributed among 104 families.

Hosagoudar and Archana (2009) described and illustrated two new species, viz *Asterina psychotriicola* on *Psychotria* sp. and *Lembosia salaciae* on *Salacia* sp. from the Western Ghats of Peninsular India. In another study, Hosagoudar *et al* (2009) collected leaf fungi from Shillong. Of these, *Asteridiella phukanea, Asterina schimae, Meliola meghalayensis, M. shillongensis, Questieriella zanthoxyli, Sarcinella castanopsidis* and *S. lyoniae* were the new

species. While, *Asterina indica, A. hakgalensis* and *Meliola rubiella* were reported for the first time from the state of Meghalaya. The study also indicates that North-Eastern region of India is a treasure of foliicolous fungi and its systematic study may bring out several undescribed new species.

Hosagoudar and Riju (2009) described and illustrated three species of the genus Schiffnerula and a species of Sarcinalla. Of these, *Schiffnerula terminaliae* was the new species, *Schiffnerula brideliae* and *S. ricinii* were reported for the first time from India and *Sarcinalla allophyli* was re-located from the present high altitudinal place.

A new species, *Balladyna salaciae*, infected the leaves of *Salacia oblonga*, collected from Silent Valley National Park of Palghat district in Kerala state was described and illustrated by Hosagoudar *et al* (2009). Hosagoudar and Thomas (2009) described and illustrated two species of the genus *Dysrhynchis,* viz *D. palmicola* and *D. uncinata* collected on the leaves of *Elaeis guineensis* and *Ochlandra travancorica* from Kerala state.

A new genus *Maheshwaramyces,* with the type, *M. pachygones*, infected the leaves of *Pachygone ovata* was described and illustrated by Hosagoudar *et al* (2009). This new genus belongs to the family Lembosiaceae of the order Asterinales.

Harsh and Hosagoudar (2009) described the foliicolous fungus, *Meliolaster aporusae* infecting leaves of *Aporusa sp.* as a new species. Meliolaster

forms a new generic report from India. Chandraprabha and Hosagoudar (2009) described and illustrated three new taxa of the genus *Asterina*. Of these, *Asterina enicostemmatis* and *A. scleropyri* were found the new species, while, *A. lobulifera* var. indica the new variety, collected from the Western Ghats region of Kerala State.

A new genus *Bramhamyces* with its type *Bramhamyces ilicis* and two new species of the genus *Prillieuxina*, viz *P. diospyri and P. ixorigena* were reported by Hosagoudar and Chandraprabha (2009).

Thomas and Sabeena (2009) reported the genus *Humboldtia* comprises six species, of which five are reported from India. All these five species are endemic to Peninsular India. It was further revealed that of these, *Humboldtia unijuga* and *H. vahliana* were infected with three species of the genus *Lembosia*, namely, *Lembosia humboldtiae, L. humboldtiicola* and *L. humboldtiigena*. The former species was described from Kerala State and the latter two are described here as new to science.

In another study Thomas and Sabeena (2009) described and illustrated five taxa of the genus *Meliola*. Of these, *Meliola dioscoreacearum, M. dioscoregena* and *M. vazhachalensis* are the new species, while, *M. erythrinae* var. *indica* and *M. strophanthicola* var. *indica* are the new varieties collected from the Western Ghats region of Kerala state. Riju and Hosagoudar (2009) reported a

new species of the genus *Meliola,* viz *M. vatsavayai*, infecting the leaves of *Zanthoxylum rhetsa* (Rutaceae), collected from Wayanad.

Thomas and Hosagoudar (2009) described and illustrated two new species of the genus *Sarcinella,* viz *Sarcinella cipadessae* and *Sarcinella quisqualidis*, infected the leaves of *Cipadessa baccifera* and *Quisqualidis indica. Asterolibertia mangiferae* and *Phyllachora travancorica* the two fungi re-located after a lapse of fifty years by Archana and Sabeena (2009).

Simon and Crous (2009) based on molecular phylogenetic results obtained from complete SSU and partial LSU data, showed that the ascomycetes genus *Cymadothea,*Type sp. *Cymadothea trifolii* a member of the Dothideomycetes belongs to the *Mycosphaerellaceae* (*Capnodiales, Dothideomycetes*). This was the first report of sequences obtained for an obligate biotrophic member of *Mycosphaerellaceae*.

Kirschner (2009) distingished *Cercosporella* and *Ramularia* (hyphomycetous anamorphs with relationship to *Mycosphaerellaceae, Ascomycota*), using newly discovered morphological characteristics of interactive structures and ultrastructure of conidiogenous loci with LSU rDNA sequence analysis of *C. virgaureae* and *Ramularia* species. Further it was revealed by Kirschner (2009) that Scanning electron microscopy of conidiogenous loci also provide additional characteristics for distinguishing *Cercosporella* and *Ramularia.*

Conidiogenous loci are smooth in *Cercosporella* but similar to the *Cladosporium*-type (consisting of a circular rim and a central dome) in *Ramularia.*

Two new fungal species *Baladyna indica* and *Eupelti indica* were reported by Hosagoudar (2009) on leaves of Rubiaceae and Oliaceae members respectivily from Sairandhri, Silant valley, Palghat Kerala. *Baladyna indica* is closely related to *Baladyna deightonii* Hansf (Hosagoudar) in having more than 100µm mycelial setae and 25µm long ascospores. However, *Baladyna indica* is known to differ from it in having entire appressoria (Hosagoudar 2009). It is also known to differ from *Baladyna rubiacearum* Hosag. in having oblong and entire appressoria (Hosagoudar 2004). Arx and Muller (1975) have placed *Maurodothina* G. Arnuad ex Piroz and Shoemaker to *Eupelte* Syd. Sivanecan (1984) has stated that the genus *Eupelte* is similar to *Maurodothina* but differs from it in absence of conidiogenous appressoria.

Crous, *et al* (2009) showed that *Mycosphaerella* species should best be limited to taxa with *Ramularia* anamorphs, with other well defined clades in the *Mycosphaerellaceae* representing *Cercospora*, *Cercosporella*, *Dothistroma*, *Lecansticta*, *Prhaeophleospora*, *Polythrincium*, *Pseudocercospora*, *Ramulispora*, *Septoria* and *Sonderhenia.* The genus, *Teratosphaeria* accommodates taxa with *Kirramyces* anamorphs, while other clades supported in the *Teratosphaeriaceae* include *Baudoinea*, *Capnobotryella*, *Devriesia*, *Penidiella*, *Phaeothecoidea*, *Readeriella*, *Staninwardia* and *Stenella.* The genus *Schizothyrium* with *Zygophiala*

anamorphs is supported as belonging to the *Schizothyriaceae*, while *Dissoconium* and *Ramichloridium* appear to represent a distinct family. In this study it was further observed that several clades remain unresolved due to limited sampling. *Mycosphaerella*, which has hitherto been used as a term of convenience to describe ascomycetes with solitary ascomata, bitunicate asci and 1-septate ascospores, represents numerous genera and several families yet to be defined.

Hunter *et al* (2009) studied taxonomic history, epidemiology, host associations and molecular biology of Tetrasphaeria nubilosa. *Teratosphaeria nubilosa* was observed a primary pathogen of several *Eucalyptus* spp.

Plan of Work

Plan of work

The foregoing survey of literature reveals that great deal of work has been carried out all over the world on the foliicolous fungi infecting crops of economic importance. However not much of the work have been carried out on the foliicolous fungi associated with on plants grown all over Aligarh. Therefore, the present study entitled "*Studies on foliicolous fungi associated with some plants*" was carried out with the following plan of work:-

1. Survey and collection of leaf samples from different plants grown at Aligarh.
2. Isolation of foliicolous fungi from leaves of plants using different culture media.
3. Identification of foliicolous fungi using morphological and reproductive charecteristics.

Materials and Methods

Materials and Methods

Fungi are of great interest, not only for the economic problems that they cause, but also for their enormous diversity. In order to have a good understanding of the morphological, reproductive and other charecteristics, various methods are used in the study of fungi;

1. Collection.
2. Sterilization.
3. Preparation of culture media.
4. Isolatio
5. Staining
6. Variability.

1. Collection of material:

For the taxonomical purposes infected leaves of many plants at different seasons of the year were collected from different sites of Aligarh. These collected specimens were put in polythene bags and brought to laboratory for isolation, culturing and identification of foliicolous fungi. The date and place of collection were also noted.

2. Sterilization:

Micro-organisms are present everywhere. These organisms contaminate all the equipments used for the study. In the isolation of micro-organisms for detailed study, one must take utmost care to avoid the contaminants. The sterilization means making free from organisms. A maximum care is taken in sterilizing the media, glassware and other instruments used in the culture technique to obtain a pure culture of any organism free from contamination. Some important methods of sterilization are as follows:

a. Sterilization by heat.

i. Dry heat sterilization.

ii. Wet heat sterilization.

b. Sterilization by Ultra-violet rays.

a. Sterilization by heat:

Heat is most commonly applied in the mycological laboratories for sterilization.

i. **Dry heat sterilization:** Direct heating of the instruments on a flame is an easy way of sterilization. Inoculation needles, scissors, forceps, scalpels, etc. are commonly sterilized by direct heat. The neck and mouth of specimen tubes, flasks and culture tubes are also passed through flame till they become sterilized. The

process of sterilizing the articles with flame is called flaming. Another method of dry heat sterilization is to keep thoroughly washed equipment and glass wares, such as petri dishes, beakers, flasks, specimen, tubes, etc. in a hot air oven. The apparatus should not be too closely packed to allow the air to circulate. It is wrapped or kept in containers so that they remain sterilised after treatment. The optimum temperature for sterilization is directly related with the time duration (Table 1)

Table.1. Optimum temperature and time required for sterilization.

Temp. °C	Time
120	8 h
140	3 h
160	1 h
180	20 min

ii. **Wet sterilization:** Wet heat (steam) is more efficient and preferred in sterilizing the media used for culturing fungi.

Autoclaving: Most media can be sterilized by heating at 10-15 p.s.i. or under metrication "one bar gauge pressure" (15lb/in^2) (10^5 Newtons/m^2) for 15 min in an autoclave or domestic pressure cooker. However, this pressure used for sterilization of media changes with different temperature (Table. 2).

Table 2. Autoclave pressure and approximate temperatures for sterilization of media

Pressure.p.s.i	Temperature ^{0}C
107	5
110	7
115	10
121	15
126	20

b. Sterilization by UV-rays:

Sterilization by UV-rays is usually done with UV lamp. The UV- rays are especially utilized for sterilizing culture rooms. The material to be sterilized is taken in special glass tubes which do not absorb UV-rays and are exposed to radiations for an hour. In the present study, I have followed the above methods for sterilization.

3. Preparation of cultural media:

The fungi are grown on suitable culture medium. A culture medium is the solution of different chemicals which support the growth of micro-organisms. In the present study, the fungi were grown on Potato Dextrose Agar (PDA) media. The exact composition of PDA is as under:

Potato Dextrose Agar

Peeled Potato	250 g
Dextrose	20 g
Agar -Agar	20 g
Water	1000 ml
pH	6.0 to 6.5

4. Isolation of fungi:

The isolation of plant pathogenic fungi is often complicated because the occurance of secondary superficial saprophytic species. To remove these saprophytes the streaking methods have been employed.

Streaking technique: Streaking is most widely used method of isolation. The fungi are picked up with the help of sterilized loop and is streaked back and forth across the surface of agar medium. The needle is flamed and allowed to cool after each streaks is made on the medium. The streaking is done in some definite plan. The care is taken not to break the surface of the medium during streaking.

5. Staining:

The purpose of staining is to view the fungi more clearly which are to be viewed under microscope. The mounting mediun for fungi used in the present study was Amans lectophenol, a stain such as cotton blue prepared in lectophenol

(Hawksworth, 1974). Various stains and mounting media with their composition commonly used are as under

(i). **Lactophenol**

Phenol	20 ml
Lactic acid	20 ml
Glycerol	40 ml
Distilled water	20 ml

(ii). **Cotton blue**

Cotton blue	0.05 g
Water	20 ml

Saturated solution

Cotton blue in 95% alcohol	10 ml
Glycerine	10 ml
Distilled water	80 ml

6. Variability:

Variability was used as a tool for the identification of foliicolous fungi isolated from leaves of different plants and cultured on different media. The methods employed to study the variability of the foliicolous fungi are based on the following study.

Morphological variability: The foliicolous fungi were identified on the basis of morphological characters like colour and size of vegetative hyphae, shape, colour and size of sporangiophore, conidiophores; asexual spores like conidia/zoospores, asexual spore bearing structures like sporangium, pycnidium, acervuli both on hosts as well as in culture media. The morphology exhibited by spores or conidia were assessed by measuring the diameter of at least 100 spores or conidia from each sample. The difference in shape or any other morphological characters were also recorded.

Results and Observation

Results and Observations

Exploration, Collection and Identification of Foliicolous fungi:

The present study entitled "*Studies on foliicolous fungi associated with some plants*" was undertaken to explore and identify the foliicolous fungi associated with some plants in A.M.U.Campus. After a thorough servey of different areas, several species of foliicolous fungi were collected and identified on the basis of morphology, reproduction and other charecteristics. Out of these collections one new genus *Exosporodiella* with type species *Exosporodiella phoenixesa* gen. et sp. nov. is recorded. The general description of these foliicolous fungi is as under

1. Meliola alstoniae Koord.

Colonies amphigenous, mostly epiphyllous, dense, velvety, upto 4 mm in diameter, confluent. Sometimes colonies alone on lower surface cause yellow lesions around the colonies. Hyphae on upper surface of the leaves, substraight, branching opposite at acute angles, loosely reticulate, cells 18-40 x 6-7 μm. Hyphae were on the lower surface of the leaves, strongly adherent and crooked. Hyphopodia (both on epiphyllous and hypophyllous colonies) alternate, straight, spreading to antrorse, 16-24 μm long; stalk cells cylindrical to cuneate. 4-8 μm long; head cells ovate, angular, entire to sublobate, 12-16 x 8-10 μm. Phialides borne on a separate mycelial branch were opposite to alternate, ampulliform, 13-

Figure-a

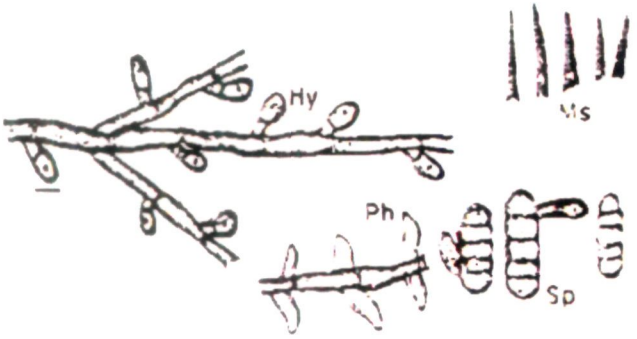

Figure-b

Figure-a: Leaf of Alstonia scholaris
Figure-b: *Meliola alstoia;* Hy=Hyphae, MS=Mycelial setae, Ph=Phialides, Sp=Spore.

18 x 6-8 µm. Mycelial setae were fairly numerous, scattered in groups around, straight, simple, and acute at the tip, upto 441 µm long. Perithecia scattered, verrucose, upto 207 µm *in* diam; ascospores oblong, 4-septate, slightly constricted, 34-40 x 12-18 µm.

*2. **Meliola mangiferae*** Earle,

Colonies hypophyllous, thin, velvety, upto 4 mm in diameter. Hyphae were substraight to crooked, branching opposite to irregular at wide angles, loosely reticulate, cells 27-40 x 5-6.5 µm. Hyphopodia alternate, mostly unilateral and variously curved, 24-31 µm long; stalk cells cylindrical to cuneate, 3-6.5 µm long; head cells ovate, versiform, attenuated and rounded at the apex, entire, predominately curved, 21-25 x 9-12.5 µm. Phialides mixed with hyphopodia, alternate to opposite, elongated, 21-28 x 8-9.5 µm. Mycelial setae scattered, simple, straight, acute, and obtuse to 2-3 dentate at the tip, upto 860 µm long. Perithecium scattered, verrucose, upto 175 µm, surface cells conoid and projecting; ascospores obovoidal to elliptical, 49-56 x 18-22 µm.

*3. **Meliola memecyli*** Sydow & Sydow,

Colonies were amphigenous, subdense, velvety, upto 5 mm in diameter, confluent. Hyphae substraight to flexuous, branching opposite to irregular at wide angles, closely reticulate, cells 22-24 x 6-8 µm. Hyphopodia were alternate, about 5% opposite, straight to variously curved, subantrorse to spreading, 18-30 µm

Figure-a

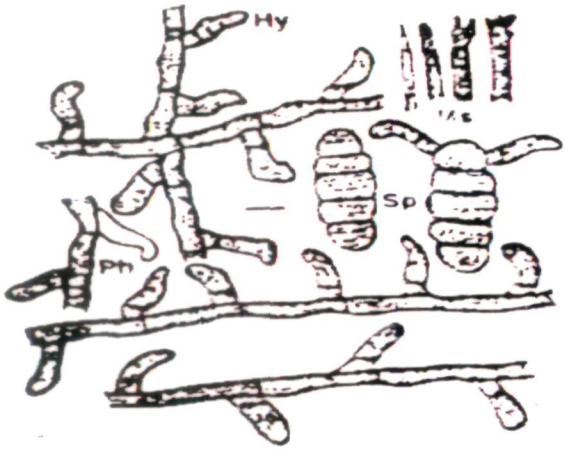

Figure-b

Figure-a: Leaf of Mangifera indica
Figure-b: Meliola mangiferae; Hy=Hyphae, Ms=Mycelial setae, Ph= Phialides, Sp=Spore.

Figure-a

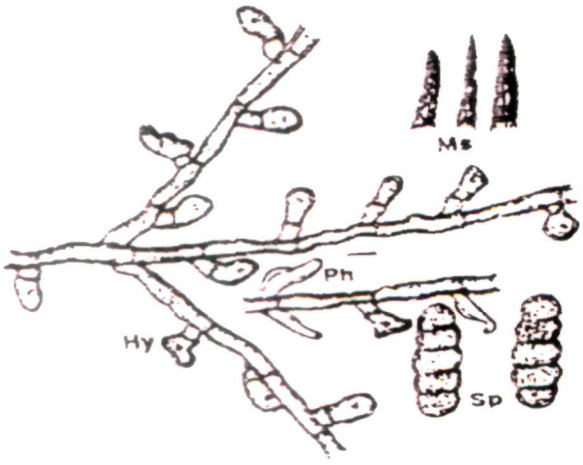

Figure-b

Figure-a: Leaf of *Carrisa congista.*
Figure-b: *Meliola memecyli;* Hy=Hyphae, MS=mycelia setae, Ph=Phialide, Sp=Spore

long; stalk cells cylindrical to cuneate, 4-1.0 µm long; head cells ovate, cylindrical to conoid, entire, 16-18 x 8-10 µm. Phialides mixed with hyphopodia, opposite to alternate, ampulliform, 20-30 x 8-10 µm. Mycelial setae were few, scattered, simple, and acute to variously dentate at the lip, upto 1080 µm long. Perithecia scattered, verrucose, upto 204 µm in diam, ascospores obovoidal, 4-septate, constricted, 40- 54 x 17-24 µm.

4. ***Amazonia peregrina*** Sydow & Sydow,

Colonies amphigenous, mostly hypophyllous, crustaceous, upto 2 mm in diameter, confluent Hyphae straight to undulating, branching alternate to opposite at acute angles, closely reticulate, forming solid mycelial mat and impart thalloid appearance, cells 13-16.5 x 6-8 µm. Hyphopodia alternate to unilateral, very closely arranged, antrorse, straight to curved, 13-16.5 µm long; stalk cells cuneate, 3.5-5 µm long; head cells globose, entire, 10-13 x 10-11.5 µm. Phialides mixed with hyphopodia, alternate, ampulliform, 13-16.5 x 6.5-8 µm. Perithecia mostly aggregated , flattened, globose, glabrous, black, upto 280 µm in diam.; ascospores cylindrical to obovoidal, 4-septate, constricted, 36-43 x 13-16 µm in size.

5. ***Cladosporium herbarum*** (Pers.) Link ex S.F. gray,

Colonies, effuse, olive green or olivaceous, greenish black. *Stroma* often well developed. Conidiophores straight or flexuous, sometimes geniculate, often nodulose, olivaceous brown to brown, smooth upto 250 µm long, 3-6µm thick,

Figure -a

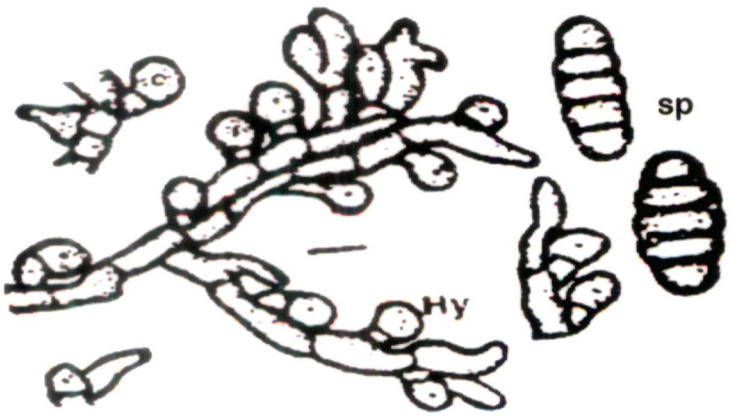

Figure-b

Figure-a: Leaf of Cestrum nocturnum
Figure-b: *Amazonia pergrina*: Hy= Hyphae; Sp= Spore.

intercalary vesicular swellings 7-9 µm diam. Conidia were in branched chains, ellipsoidal or oblong rounded at the end, olivaceous brown, thick walled, verrucose, 0-1 septate, 8-15 x 4- 6 µm with scar at one or both the side, clearly protuberant

6. *Alternaria alternata* Fr. Kiessel

Colonies epiphyllous, effuse, dark blackish, represented by very fine dots. Mycelium immersed, branched, septate, light olivaceous, smooth, setae and hyphopodia absent. Stromata well developed, immersed, dark brown to black 29-250 × 38-101.5 µm, pseudoparanchymatous. Coniodophores mostly arising from stromata, fasciculate, solitary or in loose fascicules, macronematous, mononematous, septate, straight or flexuous, errect, geniculate, simple to branched with one or several scars. Conidiogenous cell integrated, terminal or intercalary, sympodial. Conidia solitary as well as catenate, acropleurogenous ovoid and rostrate, slightly curved, tapering gradually to the beak, upto half the length of conidium swollen at the tip with one or several scars, dark olivaceous brown, smooth thick wall, usually constricted at septa, with 1 to 7 transverse septa and several longitudinal, oblique septa, germinating conidia also present, 11.5-81.5 × 6-11.5 µm.

Figure -a

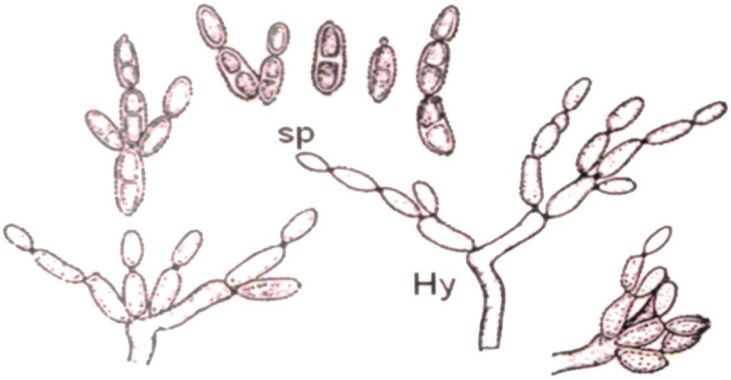

Figure-b

Figure-a: Leaf of *Rosa indica*
Figure-b: *Cladosporium herbarum*; Hy= Hyphae, Sp= Spore.

7. ***Exosporodiella*** Athar and Azam

Mycelium subimmersus, pallidulus ere hyalinus, ramosus, multiseptatus. Conidiomatum acervulatus, superficialis, perobscurus, emerrgo epidermatis, aplanatus, erumpaens conspicuous aperio centrum, separatism, uniloculus, crassitunicatus, fuscus, textura cotortus superne et apud in eam partem, fuscus ad basis textura angularis. Conidiophorum praelongus, filiformis maxime, ramulus cylindraceus ad inaequalis, ad basis, hyalinus cum multi septatus, aggrego in synnematis, convenio de loularia acervulatus in aerobius, aridus et flexuous. Conidiiferus cellula entroblastic, phialidis determinate, integratus, hyalinus, glabrescens cum appendix lateralis confestim infra setutum appendis minutus ad polyphialidis. Conidia hyalinis, aseptatus ad uniseptatus, cylindricus aut curvatus, allantoides, saepe truncates, tenuitunicatus, laevis, biguttulatus

Mycelium immersed, pale brown to hyaline, branched, septate. Conidiomata acervulate, superficial, dark blackish brown, pushing up a flap of epidermis, aplanate but markedly erumpent and open in the center, separate, unilocular, thick walled, wall several cell thick of dark brown, textura intricate above and at the side, at base dark brown textura angularis. Conidiophores very long, filiform, cylindrical to irregular, branched at the base, hyaline, with many septa delimiting cells, aggregated into synnemata coming out from acervulate locule into the air, dry and flexuous. Conidiogenous cells enteroblastic, phialidic, determinate, integrated, hyaline, smooth with lateral aperture immediately below

Figure -a

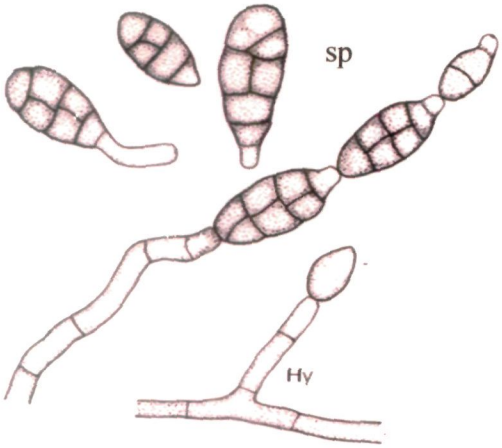

Figure-b

Figure-a: Leaf of *Ziziphus numularis*
Figure-b; Alternaria alternata; Hy= Hyphae, Sp= Spore.

the transverse septa, apparatus extremely small, and polyphialidic. Conidia hyaline, aseptate to one septate, cylindrical, or slightly curved, allantoids, often truncate, thin walled, smooth and guttulate.

Species typica: *Exosporodiella phoenixesa*

Exosporodiella phoenixesa Athar and Azam

Conidiomatum acervulatus, 800-1200 um in diametero. Conidiophorum ad 2000 um longus, 5.0 um latusconveniosemiapertus loculus, flexuous, aridus ad aerius. Conidium 4-8 um.

Conidiomata acervulate, 800-1200 µm in diameter. Conidiophores upto 2000 um long and upto 5.0 µm wide at the base, each aggregated into synnemata coming out from open locule of acervular, flexuous, aerial, dry, septate and thin walled. Conidia 4-8 µm in size.

On *Phoenix* leaves, Aligarh Muslim University Campus, Aligarh, India, Dated 31.01.2009 collected by Athar Ali Ganie (Research Scholar) under the supervision of Prof. Mohammad Farooq Azam, HCIO (Holotype) NCFT No.

Figure-a

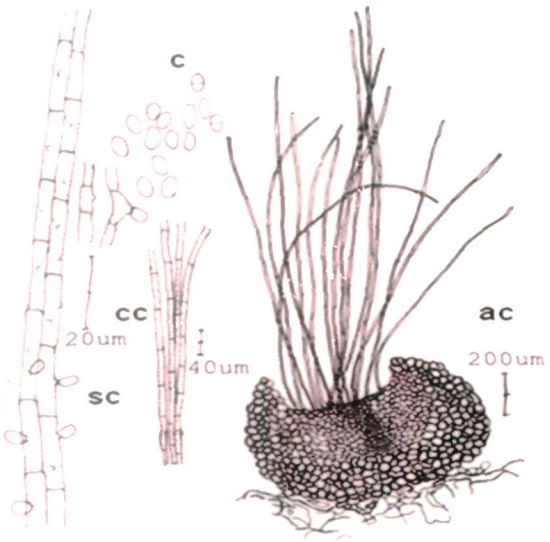

Figure-b

Figure-a: Leaf of *Phoenix indica.*

Figure-b: *Exosporodiella phoenixesa*; aC= Acervulate conidiomata, SC. Synnematous conidiophores, CC. Conidiogenous cell, C. Conidia

Disscussion

Fungi are important components of biodiversity. Based on 15 fungal monographs, one can calculate a ratio of 2.5 synonyms for each "good" species. This ratio suggests that of the 250,000 species names in existence 100,000 of these are accepted species. Because only 27,000 are treated in the modern literature, there are 28,000 currently unadopted "orphan" species. Although this is not a major portion of the absentees, it does make the total number of expected species more realistic.

Fungi traditionally have been distinguished on the basis of morphological characters. However, genetic and molecular data suggest that there are many functional biological species masquerading under a single species name or recognised only at an intraspecific rank or as a "special form". It is striking that almost every fungus critically studied by population biologists is found to comprise a number of reproductively isolated "biological species". Similarly, study were undertaken to establish species identities in species complexes such as *C. herbarum* (Schubert *et al,* 2007b) and *C. sphaerospermum* (Zalar *et al,* 2007, Dugan *et al,* 2008). In distinguishing such biological species as formally described taxa, the biological information characteristics of that entity, such as, its host range, pathogenicity, and growth conditions, likewise may be distinguished. If a biological species concept were adopted for all fungi, a case could be made for

multiplying the existing total number of species in some groups by a factor of five or more.

It is evident from the literature that a very little work has been carried out on the foliicolous fungi attacking many plants at Aligarh. Therefore the present study was carried out with the main aim of isolation, culture and identification of foliicolous fungi from Aligarh and adjoining areas. It was revealed from the present study that plants such as *Alstonia scholaris, Mangifera indica, Carrisa congista , Cestrum nocturnum , Rosa indica, Ziziphus numularis* and *Phoenix indica* were attacked by number of foliicolous fungi resulting in great losses. These foliicolous fungi were identified on the basis of morphological and reproductive charecteristics and microscopic studies. About six species of foliicolous fungi were reported from plants such as *Alstonia scholaris, Mangifera indica, Carrisa congista , Cestrum nocturnum , Rosa indica,* and *Ziziphus numularis*. These six species of foliicolous fungi are *Meliola alstoniae, Meliola mangiferae, Meliola memecyli, Amazonia peregrine, Cladosporium herbarum, Alternaria alternata* respectivily. Most of these foliicolous fungi have been reported for the first time from Aligarh. Besides these, a genus new to science, *Exosporodiella* gen. nov with a type species *Exosporodiella phoenixesa* sp. nov. have been reported for the first time. Previously, in some groups of fungi, there has been a tradition of describing species as new if the fungus is found on a new host plant. This can lead to the unnecessary proliferation of species names, but it

also can mask situation in which more than one species of a fungal genus occurs in a single host. When critically examined, many of these fungi can be keyed out based on morphological criteria alone, without reference to the host. This was the case in a recent study on *Meliola* in Kenya (Giuseppe *et al,* 1999). The net effect of this tradition is unknown, but experience at IMI suggests that in groups such as *Cercospora* and *Meliola* too few, rather than too many species are currently being recognised. Recently work on species of *Alternaria* on *Citrus* exemplifies the situation in which isolates from one host are uncritically identifies as a single, while, in reality, a number of distinct fungal species occur on that host.

It was clear from the results that seven foliicolous fungi such as; *Meliola alstoniae, Meliola mangiferae, Meliola memecyli, Amazonia peregrine, Cladosporium herbarum, Alternaria alternata* and *Exosporodiella phoenixesa* were responsible for the leaf diseases on standing flora in different localities of Aligarh. The presence of these foliicolous fungi have also been reported all over the world (Hansford, 1956, Farr, 1987 and Crous and Wingfeild, 2009) including India (Khan and Kamal, 1962, Singh and Chawdhary, 1996, Hosagoudar and Abraham, 2000, Hosagoudar, 2004 and Jana and Ghosh, 2005).

During the present study on the basis of morphological and reproductive characteristics, it was observed that the genus *Meliola* in Aligarh is represented by three species, viz. *Meliola alstoniae, Meliola mangiferae* and *Meliola memecyli. Meliola alstoniae* which were found responsible for causing foliar diseases of

Alstonia scholaris. Similar study was carried out by (Koord). *Meliola mangiferae* cause foliar diseases of *Mangifera indica.* The morphological and reproductive features of *Meliola mangiferae* was in agreement with those recorded by (Jana *et al*) on *Mangifera* species and (Earle) on *Mangifera indica. Meliola memecyli* were found associated with *Cassia fistula* and *Meliola memecyli* have also been reported earlier associated with the leaves of *Memecylon depressum* (Sydow and Sydow) and *Memecylon elude* (Sydow and Hansford).

The present study reflects that on the basis of morphological characteristics *Amazonia peregrine* was responsible for causing leaf diseases of *Pongamia pinnata. Amazonia peregrine* have also been earlier reported to cause leaf diseases of *Embelia basal* (Sydow and Sydow) and *Embelia viridiflora* (Sydow and Sydow). *Alternaria alternata* is considered as most frequent reported *Alternaria* species responsible for foliar disease of some plants (Fr. Keissel, 1912). In the present study, on the basis of morphological and reproductive charecteristics, the fungus responsible for leaf disease of *Jatropha pendrafolia* was identified as *Alternaria alternata.* Similar study was carried by (Ellis, 1971).

It was also revealed from the study that *Cladosporium herbarum* was responsible for foliar diseases of *Rosa indica* in different localities of Aligarh. *Cladosporium herbarum* have also been reported on leaves of *Hordeum vulgare* (Crous *et al*, 2007). Sharma *et al,* (1998) described and illustrated three species of Cladosporium, viz. *glochidionis, C. malvacearum* and *C. kapildha- rens* causing

leaf spot diseases of Angiospermic flora from the Nepal Himalaya. However, in the present study *C.herbarum* have been reported. Schubert *et al,* (2003) reported *Cladosporium chlorocephalum* (*C.* paeoniae) causing leaf block symptoms on *Poenia* species. Several species of *Cladosporium* have been earlier associated with leaf diseases of several plants (Braun and Crous, 2003 Schubert *et al,* 2007 and Ragvendra *et al,* 2008). *C. leguminicola* have been reported from leaves of *Phaseola vulgaris* from Spain (Braun and Schubert, 2007). *C. spinacearum* on living leaves of *Spinacea oleracea* (Singh *et al,* 2008). *C. bauhiniana* on foliage of *Bauhinia variegate* (Kharwar *et al,* 2006).

It was clear from the present study that there is no genus recorded which develops aerial, dry, flexuous, long, synnematous conidiophores developing from the acervulate conidiomata (Sutton). However, ours specimen was compared with *Stilbophoma* Petrak (1941), *Phacidiella* Karst (1974), *Catenophora* Luttrel (1940), *Robenhorstia* Summa (1849), *Endobotryella* Hohn. (1909), *Cheirospora* Moug. & Fr. (1825). Two new genera from Phoenix *Endomelanconium* Petrak (1940) were also compared but none of these fungal genera matched with our specimen hence, described here as a new genus *Exosporodiella* gen. nov with *E. phoenixesa* as the type species.

The impression of the present study is given that foliicolous fungi have wider distribution. These fungi reside in unresearched as well as known habitats explored by applying something other than the usuall isolated techniques.

Recognising the enormous diversity of foliicolous fungi is both an opportunity and a challenge. Researchers exploring this frontier uncover novel fungi that often represent new orders or families. A vast territory ripe for exploration awaits those who accept the challenge of discovering the foliar fungi

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