

## INCIDENCE OF *Alternaria alternata* ON PHYLLOPLANE OF SOME SHRUBS AND TREES OF MALL ROAD, LAHORE

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### Abstract

In the present investigation, attempts were made to investigate myco-flora of some trees of Mall Road, Lahore. Forty trees were selected for the collection of infected leaves from Mall Road Lahore for the investigation of phylloplane mycoflora. Morpho-anatomical descriptions and illustrations are presented after thorough analysis. Identification was done by light microscopy, stereomicroscopy and scanning electron microscopy (SEM). Among all the isolated fungi, *Alternaria alternata* and *Cladosporium cladosporioides* were found to be the most dominant upon the leaves of forty selected trees. It is expected that there could be a large number of leaf-associated fungi present on leaves of these trees.

**Key words:** *Alternaria alternata*, Mall Road, Epiphytes, Phylloplane, Scanning Electron Microscopy

**Novelty statement:** In current study, 19 plants species have been first time reported to be affected by *Alternaria alternata*.

### Introduction

The external surfaces of plant have been recognized as important habitats for epiphytic microorganisms. The above-portions of plants as the habitat of microbes can be expressed by the term phyllosphere e.g. phylloplane (leaves), caulosphere (stems), anthosphere (flowers), and carposphere (fruits).

In the phylloplane, the growth of microorganisms is dependent on nutrients from plant metabolites that are secreted to the phylloplane or on compounds in materials from external sources that drop on the plant surface. The plant metabolites are organic substances, mostly simple sugars e.g., glucose, fructose and sucrose, while the materials from external sources are inorganic nutrients (Limtong and Koowadjanakul, 2012). The phylloplane supports an abundant and varied microflora, with yeasts, filamentous fungi, and bacteria dominating at different times during the various stages of leaf development (McCormack, 1994).

According to Saha *et al.*, 2013, phylloplane fungi have been poorly studied as compared to endophytic, saprobic and pathogenic fungi. Phylloplane fungi mostly belong to filamentous fungal group. Filamentous fungi are made up of long, slender, branched thread like hyphae which can be septate or aseptate.

In this study, we characterized and identified phylloplane fungal flora of trees growing along the Mall Road Lahore. By selecting the 40 trees of Lahore's primary and most famous road The Mall (Shahrah-e-Quaid-e-Azam), infected plants were found belonging to 21 families. These plant families were, *Acanthaceae*, *Amaranthaceae*, *Anacardiaceae*, *Annonaceae*, *Apocynaceae*, *Asteraceae*, *Bignoniaceae*, *Burseraceae*, *Combretaceae*, *Convolvulaceae*, *Cucurbitaceae*, *Ebenaceae*, *Euphorbiaceae*, *Fabaceae*, *Lythraceae*, *Malvaceae*, *Moraceae*, *Myrtaceae*, *Rhamnaceae*, *Rosaceae* and *Sapotaceae*.

### Materials and Methods

**1. Description of sampling site:** The infected leaf samples were collected in the month of October 2014 when temperature was approximately 31° C. Trees growing along the Mall road, Lahore were covered with dust but most of them were in good conditions.

**2. Collection of infected leaf samples:** After careful inspection of trees, infected and contaminated leaves were selected. Only yellowish-brown, pale-yellowish, and spotted leaves were collected from the trees of Mall Road. Collected infected leaves were used to isolate and study the fungi present on them. Collected leaves were placed inside the paper envelopes and later on pressed with the help of plant presser.

**3. Photography of infected leaf samples:** Collected

leaves of plants were photographed by digital camera. For morphological study, infected parts on leaves were first observed under stereomicroscope and then photographed under it.

**4. Microscopy and slide preparation:** Microscopy of infected portion was done by slide preparation. For this purpose, material was collected from the infected part of the leaf with the help of a needle by observing under stereo-microscope. A drop of 10% Lactic acid was dropped on glass slide and isolated material was put into it. Material was covered by a cover-slip and observed under Labomed compound microscope (at 100× and 400× magnification). Fungal structures e.g. spore, conidia, conidiophores and other elements were measured with the help of stage and ocular micrometer. Descriptions were prepared and light micro-graphs were taken. Illustrations were first made on plain paper with the help of Camera Lucida then sketched on tracing paper. Scanning Electron Micrographs were also obtained for conidia of some fungal taxa.

## Results

A total of 9 fungal species were characterized morpho-anatomically and identified. Among them, dominant and completely identified taxa were *Alternaria alternata* (Fr.) Keissl., *A. brassicae* (Berk.) Sacc., *Aspergillus niger* Tiegh., *Cladosporium cladosporioides* (Fresen.) G.A. de Vries, *C. heterophragmatis* S.A. Khan & M. Kamal, *Curvularia lunata* (Wakker) Boedijn. However some of the taxa which were identified up to genus level were, *Alternaria* sp., *Aspergillus* sp., and *Curvularia* sp. (Table 1, Plates 1-40).

## Discussion

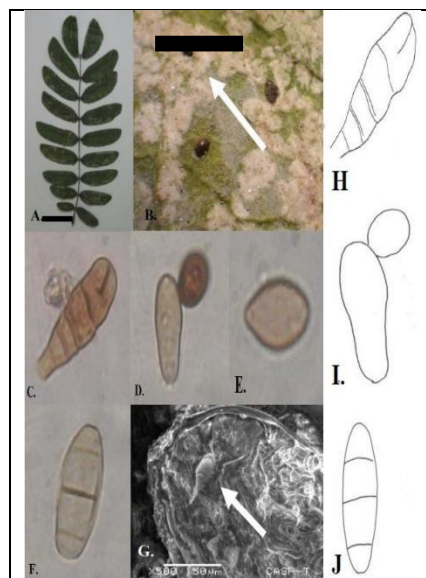
From Pakistan, it is the first report about the occurrence of phylloplane myco-flora on the trees leaves of *Alstonia scholaris* (L.) R. Br., *Bauhinia variegata* (L.) Benth., *Broussonetia papyrifera* (L.) L'Herit ex Vent., *Bursera serrata* Wall. ex Colebr., *Cassia* sp., *Cassia fistula* L., *Chrysanthemum indicum* L., *Diospyros kaki* Thunb., *Erythrina suberosa* Roxb., *Ficus* sp., *F. elastica* Roxb. ex Hornem., *F.*

*benghalensis* L., *F. racemosa* L., *F. religiosa* L., *F. virens* Aiton, *Hibiscus rosa-sinensis* L., *Ipomoea batatas* (L.) Lam., *Jatropha integerrima* Jacq., *Justicia adhatoda* L., *Lagerstroemia speciosa* (L.) Pers., *Mangifera indica* L., *Millettia pinnata* (L.) Pierre, *Mimusops elengi* L., *Plumeria obtusa* L., *Pongamia* sp., *Prunus armeniaca* L., *Senna surattensis* (Burm. f.) H. S. Irwin & Barneby, *Syzygium cumini* (L.) Skeels., *Tacoma stans* (L.) Juss. ex Kunth, *Terminalia arjuna* (Roxb.) Wight & Arn., *T. chebula* Retz., *Ziziphus jujuba* Mill. Previously, no data was reported about the existence of any kind of phylloplane myco-flora on *Alternanthera ficoidea* (L.) Sm. and *Causonia* sp., *Combretum indicum* (L.) DeFilipps, *Lagerstroemia indica* L., and *Polyalthia longifolia* Sonn. B.Xue & R.M.K.Saunders.

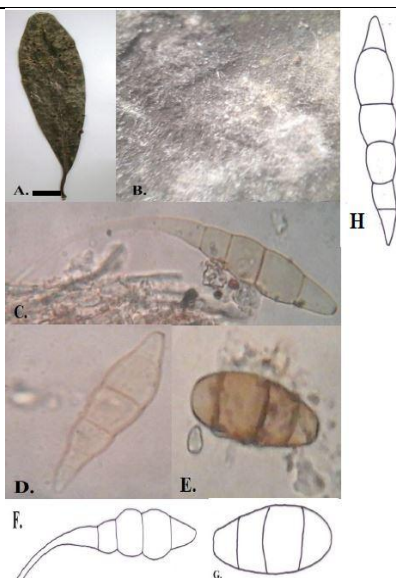
In the present work, efforts were made to investigate myco-flora of some trees of Mall Road, Lahore. Phylloplane myco-flora of forty trees were described and illustrated morpho-anatomically with the help of different techniques. Fungal characterization and identifications were made by using microscope, stereomicroscope and scanning electron microscope (SEM). This investigation was conducted to find out the diversity and species richness of filamentous fungi on leaves. In this study, *Alternaria alternata* and *Cladosporium cladosporioides* were reported on leaf surface of *Albizia lebbeck* and were characterized morpho-anatomically. According to Mushtaq *et al.* (2005), 15 yeast species belonging to 9 genera were isolated from 40 slime flux samples collected from the leaves of *Acacia nilotica* (L.) Willd. ex Delile, *Albizia lebbeck* and *Aralia cachemirica* Dcne., trees. Species isolated during his investigation from *Albizia lebbeck* were *Candida valdiviana* Grinb. & Yarrow, *Debaryomyces castellii* Capr., *D. yamadae* (Van der Walt & Johannsen) Van der Walt, M.T. Sm. & Y. Yamada, *Fibulobasidium inconspicuum* Bandoni, *Phaffia rhodozyma* M.W. Mill., Yoney. & Soneda, *P. anomala*, *P. rabaulensis* and *Sporidiobolus ruineniae* Holzschu, Tredick & Phaff. In the present investigation *Alternaria* sp. and *Curvularia lunata* were reported on the leaf surface of *Alstonia scholaris* and characterized morpho-anatomically.

**Table 1: A morpho-anatomical comparison of fungal taxa isolated from the phylloplane of tree species in current study.**

| Sr. No. | Fungal species                       | Conidiophore                       |                                 | Vesicle and phialides                                                                          | Spores/ conidia                                          |                                                                               |                                                                        | Host plants                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------|--------------------------------------|------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         |                                      | Size                               | Colour                          |                                                                                                | Size and septa                                           | Colour and shape                                                              | Texture                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 1.      | <i>Alternaria alternata</i>          | 47-106 x 0.78-1.22 $\mu$ m         | Septate, branched, olive brown  | Absent                                                                                         | 26-78 x 2.4-16.5 $\mu$ m/ 3-5 cross septa                | Obclavate cylindrical beak to ellipsoidal and light olive brown to pale brown | Smooth to warty or verrucose                                           | <i>Albizia lebbeck</i> , <i>Alstonia scholaris</i> , <i>Bauhinia variegata</i> , <i>Broussonetia papyrifera</i> , <i>Bursera serrate</i> , <i>Cassia fistula</i> , <i>Causonia</i> sp., <i>Chrysanthemum indicum</i> , <i>Diospyros kaki</i> , <i>Erythrina suberosa</i> , <i>Ficus</i> sp., <i>Ficus benghalensis</i> , <i>F. elastica</i> , <i>F. racemosa</i> , <i>Ficus virens</i> , <i>Ipomoea batatas</i> , <i>Jatropha integerrima</i> , <i>Justicia adhatoda</i> , <i>Lagerstroemia indica</i> , <i>L. speciosa</i> , <i>Mangifera indica</i> , <i>Milletia pinnata</i> , <i>Polyalthia longifolia</i> , <i>Pongamia</i> sp., <i>Senna surattensis</i> , <i>Syzygium cumini</i> , <i>Tecoma stans</i> , <i>Terminalia arjuna</i> , <i>Terminalia chebula</i> , <i>Ziziphus jujuba</i> . |
| 2.      | <i>Alternaria brassicae</i>          | 190 x 4-11 $\mu$ m                 | Branched, erect                 | Absent                                                                                         | 52.52-1.30 $\mu$ m/ Up to 10 cross septa                 | Obclavate to ellipsoidal with short beak<br>Olive-brown to brown              | Verrucose                                                              | <i>Ficus elastica</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3.      | <i>Alternaria</i> sp.                | 26-54 x 0.78-1.3 $\mu$ m           |                                 | Absent                                                                                         | 2.35 x 0.6 $\mu$ m/ 3-5 cross septa                      | Light pale yellow                                                             | Smooth and divided into several cells by transverse and vertical cells | <i>Albizia lebbeck</i> , <i>Alstonia scholaris</i> , <i>Bursera serrate</i> , <i>Cassia</i> sp., <i>Combretum indicum</i> , <i>Diospyros kaki</i> , <i>Erythrina suberosa</i> , <i>Ficus benghalensis</i> , <i>Ficus elastica</i> , <i>Ficus religiosa</i> , <i>Ficus virens</i> , <i>Justicia adhatoda</i> , <i>Milletia pinnata</i> , <i>Mimusops elengi</i> , <i>Morus alba</i> , <i>Pongamia</i> sp., <i>Prunus armeniaca</i> , <i>Terminalia arjuna</i> , <i>Terminalia chebula</i> .                                                                                                                                                                                                                                                                                                      |
| 4.      | <i>Aspergillus niger</i>             | 444-445 x 0.78 $\mu$ m             | Hyaline, dark near the vesicle  | Swollen vesicle, flask shaped phialides, 26.2 x 26.5 $\mu$ m.                                  |                                                          |                                                                               |                                                                        | <i>Mimusops elengi</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5.      | <i>Aspergillus</i> sp.               | 184-210 x 0.5-0.78 $\mu$ m         | Hyaline<br>Septate, branched    | Flask shaped phialides, 26.78-27.04 x 27.3-27.6 $\mu$ m<br>Golden in colour<br>Swollen vesicle |                                                          |                                                                               |                                                                        | <i>Cassia</i> sp., <i>Ficus</i> sp., <i>Ficus religiosa</i> , <i>Mangifera indica</i> , <i>Plumeria obtusa</i> , <i>Polyalthia longifolia</i> , <i>Senna surattensis</i> , <i>Terminalia arjuna</i> , <i>Aspergillus</i> sp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6.      | <i>Cladosporium cladosporioides</i>  | 300-522 $\mu$ m x 0.4-0.52 $\mu$ m | Hyaline                         | Absent                                                                                         | 1.56-2.08 x 0.52-0.78 $\mu$ m                            | Round, oval, cylindrical and blackish-brown                                   | Smooth wall, Single celled                                             | <i>Albizia lebbeck</i> , <i>Alternanthera ficoidea</i> , <i>Bauhinia variegata</i> , <i>Broussonetia papyrifera</i> , <i>Cassia</i> sp., <i>Cassia fistula</i> , <i>Ficus elastica</i> , <i>F. religiosa</i> , <i>F. virens</i> , <i>Hibiscus rosa-sinensis</i> , <i>Jatropha integerrima</i> , <i>Lagerstroemia indica</i> , <i>Mangifera indica</i> , <i>Prunus armeniaca</i> .                                                                                                                                                                                                                                                                                                                                                                                                               |
| 7.      | <i>Cladosporium heterophragmatis</i> | 28.08 x 1.04 $\mu$ m               | Dark brown, cylindrical, smooth | Absent                                                                                         | 15-15.6 x 0.9                                            | Ellipsoidal to limoni                                                         | Smooth walled                                                          | <i>Ficus elastica</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8.      | <i>Curvularia lunata</i>             |                                    |                                 |                                                                                                | 26-26.5 x 0.78-1.0 $\mu$ m/ 3-5 cross septa, Pointy beak | Pale to dark brown                                                            | Smooth, Pointy beak divided into several cells.                        | <i>Bursera serrata</i> , <i>Causonia</i> sp., <i>Erythrina suberosa</i> , <i>Ficus elastica</i> , <i>Ficus racemosa</i> , <i>Ficus virens</i> , <i>Ipomoea batatas</i> , <i>Pongamia</i> sp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 9.      | <i>Curvularia</i> sp.                | 106 x 0.78 $\mu$ m                 |                                 | Absent                                                                                         | 26.5-28.4 x 1.04-1.3 $\mu$ m/ 3-5 cross septa            | Olive-brown, smooth, pointy beak                                              | Smooth, pointy beak, 1 celled.                                         | <i>Cassia fistula</i> , <i>Causonia</i> sp., <i>Diospyros kaki</i> , <i>Ficus</i> sp., <i>Ficus elastica</i> , <i>F. racemosa</i> , <i>F. religiosa</i> , <i>Ipomoea batatas</i> , <i>Pongamia</i> sp., <i>Prunus armeniaca</i> , <i>Senna surattensis</i> , <i>Tecoma stans</i> , <i>Ziziphus jujuba</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



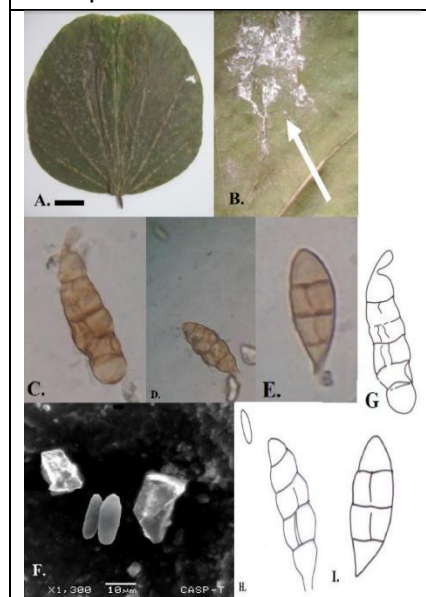
**Plate 1: *Albizia lebbeck*** A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria alternata*; D,E. Conidia of *Cladosporium cladosporioides*; F. Conidia of *Alternaria* sp. G. SEM of conidia of *A. alternata*; H. Illustration of *A. alternata*; I, J. Illustrations of *Cladosporium cladosporioides*; Scale Bar (1cm) A= 2.3cm; B= 0.6cm; C= 7.8µm; D= 1.67µm; E= 1.45µm; F= 2.48µm; H= 3.6µm; I=2.62µm; J=2.77µm



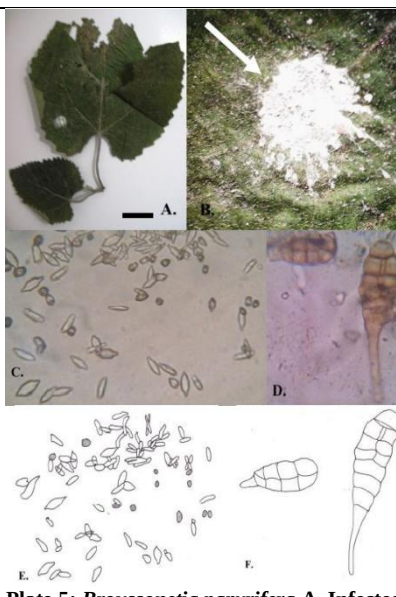
**Plate 2: *Alstonia scholaris*** A. Infected Leaf; B. Infection Site; C,D. Microscopic Photograph of Conidia of *Alternaria* sp. E. Conidia of *Alternaria alternata*; F, H. Illustrations of Conidia of *A. sp.* G. Illustration of Conidia of *A. alternata*; Scale Bar (1cm) A= 2.2cm; B= 0.1cm; C= 4µm; D= 7.7µm; E= 10.2µm; F= 3.90µm; G= 3.1µm; H= 6.8µm



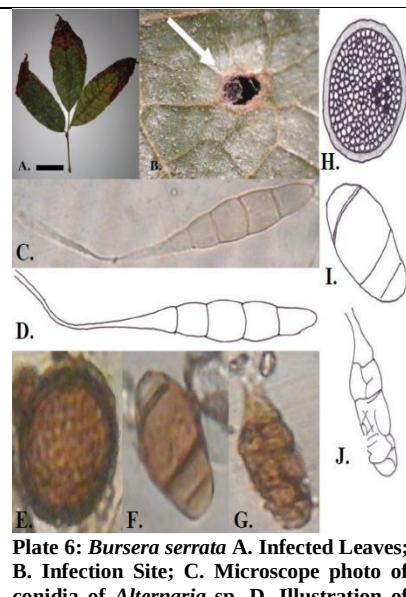
**Plate 3: *Alternanthera ficoidea*** A. Infected Leaf; B. Infection Site; C. Microscopic Photograph of Conidia of *Cladosporium cladosporioides*; D. Illustration of Conidia of *Cladosporium cladosporioides*; Scale Bar (1cm) A= 1.4cm; B= 0.2cm; C= 0.7µm; D= 0.47µm



**Plate 4: *Bauhinia variegata*** A. Infected Leaf; B. Infection Site; C-E. Microscopic photo of conidia of *Alternaria alternata*; F. SEM of conidia of *Cladosporium cladosporioides*; G-I. Illustrations of Conidia of *A. alternata*; Scale Bar (1cm) A= 1.4cm; B= 0.1cm; C=7.2µm; D= 6.72µm; E= 9.41µm; G= 3.6µm; H= 3.6µm; I=3.9µm



**Plate 5: *Broussonetia papyrifera*** A. Infected Leaf; B. Infection Site; C. Microscopic photo of conidia of *Cladosporium cladosporioides*; D. Microscopic photo of conidia of *Alternaria alternata*; E. Illustration of *C. cladosporioides*; F. Illustration of Conidia of *A. alternata*; Scale Bar (1cm) A= 1.5cm; B= 0.1cm; C= 1.33µm; D= 3.62µm; E= 1.33µm; F= 3.3µm



**Plate 6: *Bursera serrata*** A. Infected Leaves; B. Infection Site; C. Microscope photo of conidia of *Alternaria* sp. D. Illustration of conidia of *A. sp.* E. Unidentified sp. F. Conidia of *Curvularia lunata*; G. Conidia of *Alternaria alternata*; H. Illustration of unidentified sp. I. Illustration of conidium of *Curvularia lunata*; J. Illustration of conidia of *A. alternata*; Scale Bar (1cm) A= 2.8cm; B= 0.3cm; C= 2.52µm; D= 3µm; E= 6.11µm; F= 4µm; G= 6.3µm; H= 5µm; I= 4µm; J= 5.2µm

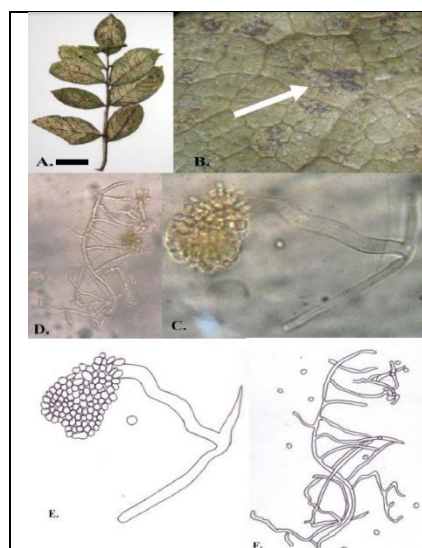


Plate 7: *Cassia* sp. A. Infected Leaves; B. Infection Site; C. Microscopic Photo of Conidiophore of *Cladosporium cladosporioides*; D. *Aspergillus* sp. E. Illustration of *A. sp.* F. Illustration of *C. cladosporioides* Scale Bar (1cm) A= 2.3cm; B= 0.5cm; C= 14.34µm; D= 61.44µm; E= 17µm; F= 50µm

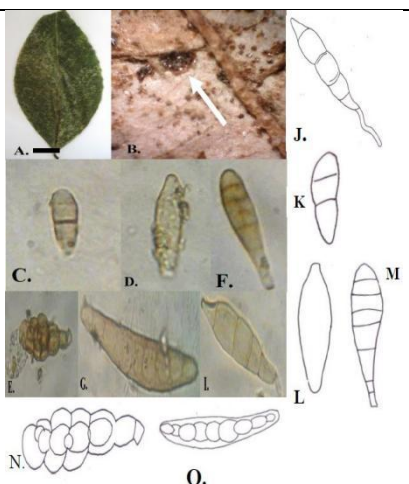


Plate 8: *Cassia fistula* A. Infected Leaf; B. Infection Site; C, I. Conidium of *Alternaria* sp.; D. Conidium of *Cladosporium cladosporioides*; E, F. Conidium of *A. alternata*; G. Conidium of *Curvularia* sp. J, K. Illustration of conidium of *Alternaria* sp. L. Illustration of conidium of *Cladosporium cladosporioides*; M, N. Illustration of conidium of *A. alternata*; O. Illustration of conidium of *Curvularia* sp. Scale Bar (1cm) A= 1.9cm; B= 0.4cm; C= 7.65µm; D= 5.1µm; E= 16µm; F= 7.8µm; G= 3.3µm; I= 11µm; J= 9µm; K= 4.5µm; L= 3.9µm; M= 7.1µm; N= 7µm; O= 4µm

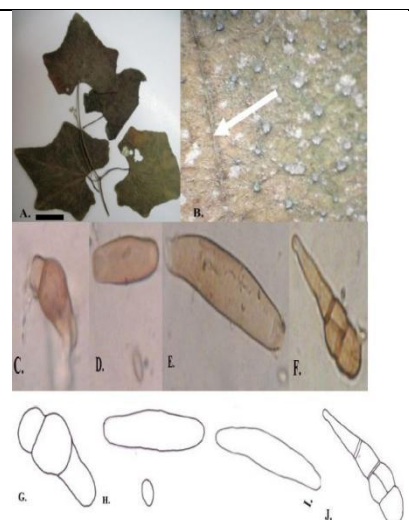


Plate 9: *Coussonia* sp. A. Infected Leaves; B. Infection Site; C. Microscopic-photo of conidium of *Curvularia lunata*; D, E. Conidia of *Curvularia* sp. F. Conidium of *Alternaria alternata*; G. Illustration of conidium of *Curvularia lunata* H, I. Illustration of conidia of *Curvularia* sp. J. Illustration of conidium of *Alternaria alternata*; Scale Bar (1cm) A= 4.0cm; B= 0.4cm; C= 5.4µm; D= 7.2µm; E= 3.4µm; F= 4µm; G= 4.3µm; H= 5µm; I= 4.2µm; J= 4.13µm

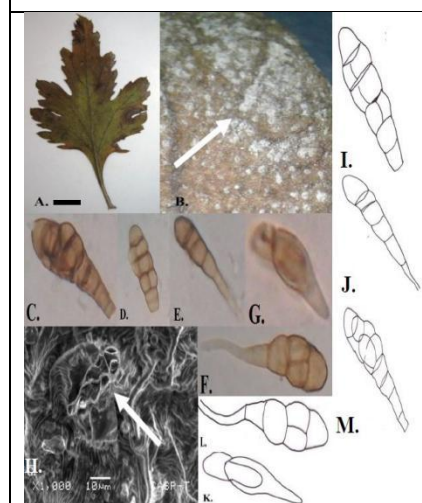


Plate 10L *Chrysanthemum indicum* A. Infected Leaf; B. Infection Site; C, F, G. Microscopic photo of conidia of *Alternaria alternata*; D, E. Conidium of *Alternaria* sp. H. SEM of *A. alternata*; I, J. Illustration of *A. sp.* K, L, M. Illustration of *A. alternata*; Scale Bar (1cm) A= 1.5cm; B= 0.13cm; C= 8.2µm; D= 15µm; E= 4.4µm; F= 7.8µm; G= 7.5µm; H= 8.8µm; I= 6.75µm; J= 4.9µm; K= 8.37µm; L= 8.8µm

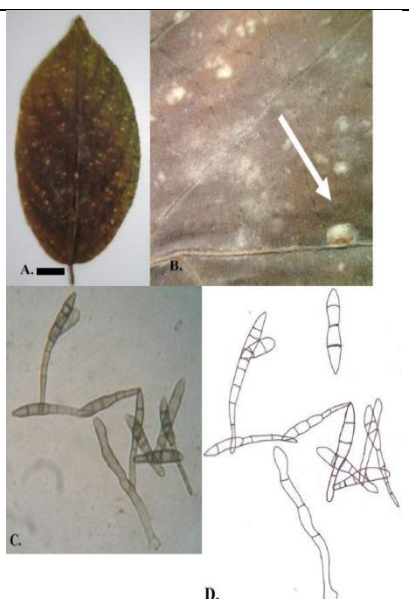


Plate 11: *Combretum indicum* A. Infected Leaf; B. Infection Site; C. Microscopic Photograph of conidia of *Alternaria* sp. D. Illustration of conidia of *A. sp.* Scale Bar (1cm) A= 1.4cm; B= 0.2cm; C= 10.7µm; D= 9.2µm

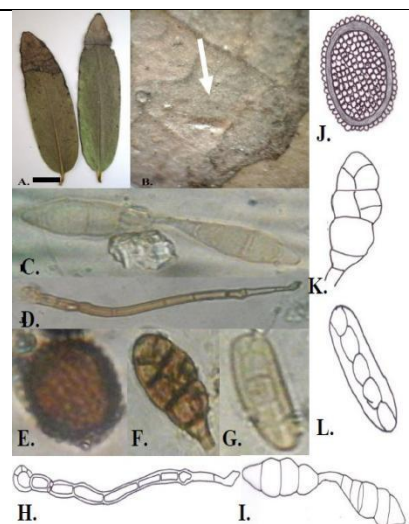
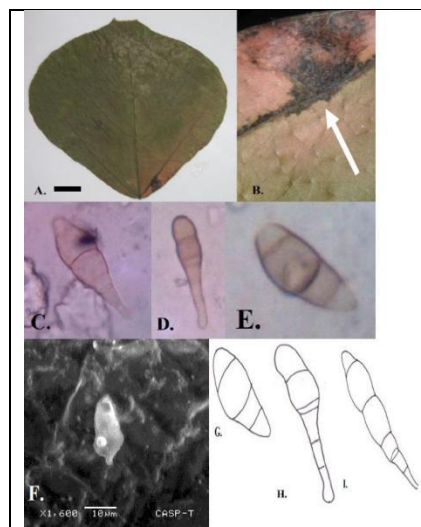
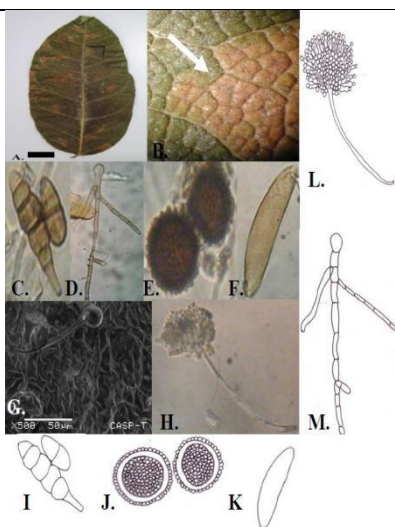


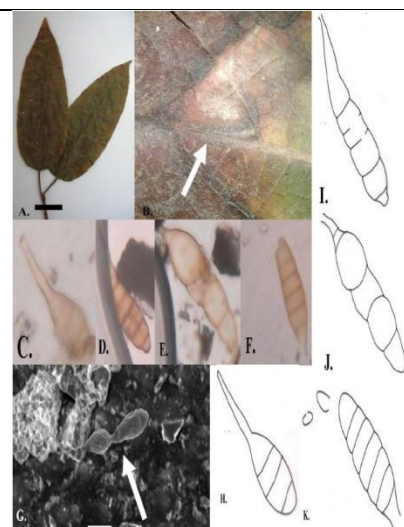
Plate 12: *Diospyros kaki* A. Infected Leaves; B. Infection Site; C. Microscopic Photograph of conidia of *Alternaria* sp. D, E. Unidentified sp. F. Conidia of *A. alternata*; G. conidia of *Curvularia* sp. H, J. Illustration of unidentified sp. I. Illustration of conidia of *A. sp.* K. Illustration of *A. alternata*; L. Illustration of *Curvularia* sp. Scale Bar (1cm) A= 1.5cm; B= 0.3cm; C= 6.9µm; D= 1.52µm; E= 6.6µm; F= 8µm; G= 4µm; H= 2.67µm I= 8.4µm; J= 5.8µm; K= 4.2µm; L= 5.8µm



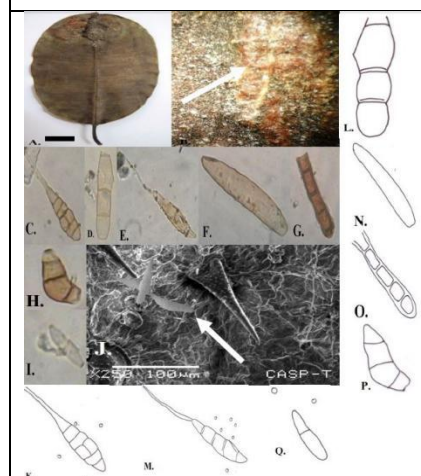
**Plate 13: *Erythrina suberosa*** A. Infected Leaf; B. Infection Site; C, D. Microscopic photograph of *Alternaria* sp. E. Conidia of *Curvularia lunata*; F. SEM of *Alternaria alternata*; G. Illustration of *C. lunata*; H-I. Illustration of *Alternaria* sp. Scale Bar (1cm) A= 1.6cm; B= 0.1cm; C= 7.4µm; D= 10µm; E= 4.10µm; G= 5.5µm; H= 7.6µm; I= 6.00µm



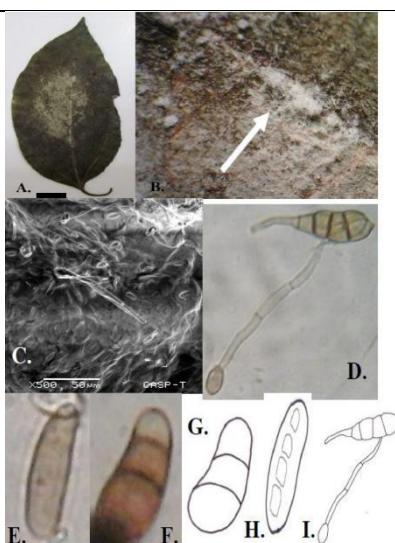
**Plate 14: *Ficus* sp.** A. Infected Leaf; B. Infection Site; C. Microscopic photo of conidia of *Alternaria alternata*; D. Conidiophore of *A. alternata*; E. Unidentified sp.; F. Conidia of *Curvularia* sp. G. SEM of *Aspergillus* sp. H. *Aspergillus* sp. I. Illustration of conidia of *A. alternata*; J. Illustration of unidentified fungal sp. K. Illustration of *Aspergillus* sp. L. Illustration of conidiophore of *A. alternata*; Scale Bar (1cm) A= 1.4cm; B= 0.4cm; C= 10.20µm; D= 10.6µm; E= 8.1µm; F= 5.7µm; H= 15µm; I= 7.36µm; J= 7.4µm; K= 4.3µm; L= 15.7µm; M= 10.74µm



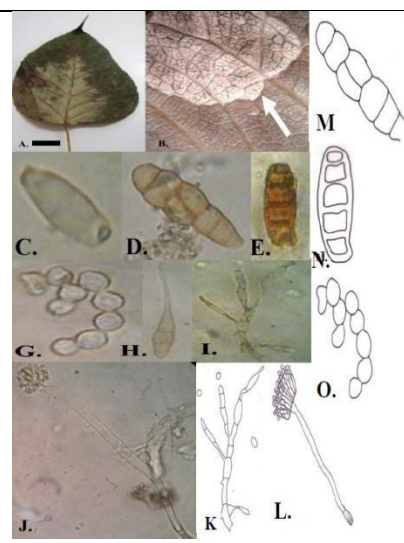
**Plate 15: *Ficus benghalensis*** A. Infected Leaves; B. Infection Site; C, D. Microscopic photograph of *Alternaria alternata*; E, F. Conidia *A. sp.* G. SEM of conidia of *A. alternata*; H, I. Illustration of *A. alternata*; J, K. Illustration of *A. sp.* Scale Bar (1cm) A= 1.5cm; B= 0.4cm; C= 4.5µm; D= 4.1µm; E= 8µm; F= 10µm; H= 4.9µm; I= 3.9µm; J= 7.21µm; K= 9.10µm



**Plate 16: *Ficus elastica*** A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria brassicae*; D. Conidia of *A. sp.*; E. Conidia of *A. sp.* F. Conidia of *Curvularia* sp. G. *Cladosporium heterophragmatis*; H. Conidia of *Curvularia lunata*; I. Conidia of *Cladosporium cladosporioides*; J. SEM of conidia of *A. alternata*; K. Illustration of *A. alternata*; L. Illustration of *A. sp.*; M. Illustration of *A. sp.* N. Illustration of *Curvularia* sp. O. Illustration of *Cladosporium heterophragmatis*; P. Illustration of *Curvularia lunata*; Q. Illustration of *Cladosporium cladosporioides*; Scale Bar (1cm) A= 2.1cm; B= 0.6cm; C= 9.8µm; D= 5.1µm; E= 8.8µm; F= 3.7µm; G= 11µm; H= 8µm; I= 1.8µm; K= 7.4µm; L= 4.8µm; M= 7µm; N= 3µm; O= 9µm; P= 6µm; Q= 0.79µm



**Plate 17: *Ficus racemosa*** A. Infected Leaf; B. Infection Site; C. SEM of Conidiophore; D. Microscopic photograph of conidia of *Alternaria alternata* and conidiophore; E. Conidia of *Curvularia* sp. F. Conidia of *Curvularia lunata* G. Illustration of *C. lunata*; H. Illustration of *C. sp.* I. Illustration of *A. alternata* and conidiophores Scale Bar (1cm) A= 1.9cm; B= 0.3cm; D= 11µm; E= 6.7µm; F= 5.2µm; G= 7.1µm; H= 9.2µm; I= 5.6µm



**Plate 18: *Ficus religiosa*** A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Cladosporium cladosporioides*; D, H. Microscopic photograph of conidia of *Alternaria* sp. E. Conidiophore of *Alternaria* sp. M. Illustration of *A. sp.* N. Illustration of *Curvularia* sp. K. Illustration of Conidiophore of *A. sp.* L. Illustration of *Aspergillus*. Sp. Scale Bar (1cm) A= 1.8cm; B= 0.2cm; C= 4.10µm; D= 7.69µm; E= 6.83µm; F= 12µm; G= 4.10µm; H= 11.9µm; I= 23.07µm; J= 13.98µm; K= 15.4µm; L= 13.43µm; M= 7.8µm; N= 5.5µm; O= 5.2µm

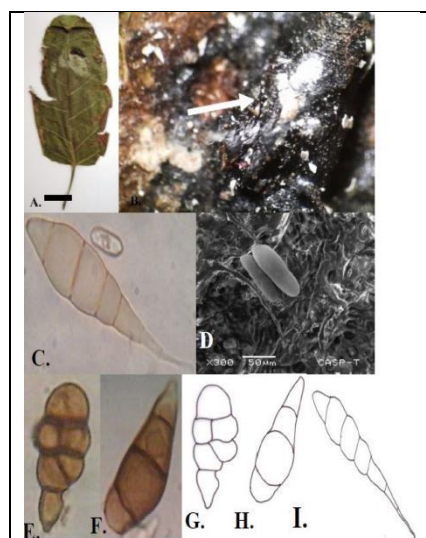


Plate 19: *Ficus virens* A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria* sp. D. SEM of *Cladosporium cladosporioides*; E. Microscopic photograph of conidia of *Alternaria alternata*; F. Microscopic photograph of conidia of *Curvularia lunata*; G. Illustration of *A. alternata*; H. Illustration of *C. lunata*; I. Illustration of *A. sp.* Scale Bar (1cm) A= 2.01cm; B= 0.08cm; C= 7.64µm; E= 5.63µm; F= 5.02µm; G= 5.50µm; H= 4.0µm; I= 6.8µm

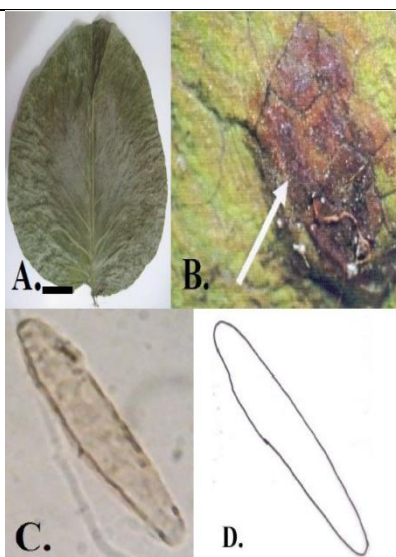


Plate 20: *Heterophragma adenophyllum* A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Curvularia* sp. D. Illustration of conidia of *Curvularia* sp. Scale Bar (1cm) A= 4.6cm; B= 0.04cm; C= 2.26µm; D= 2.29µm

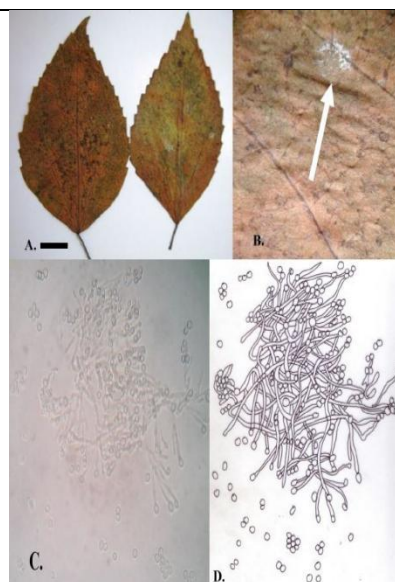


Plate 21: *Hibiscus rosa-sinensis* A. Infected Leaves; B. Infected Site; C. Microscopic photograph of conidiophore of *Cladosporium cladosporioides*; D. Illustration of conidiophore of *C. cladosporioides* Scale Bar (1cm) A= 1.0cm; B= 0.3cm; C= 58.6µm; D= 50.08µm

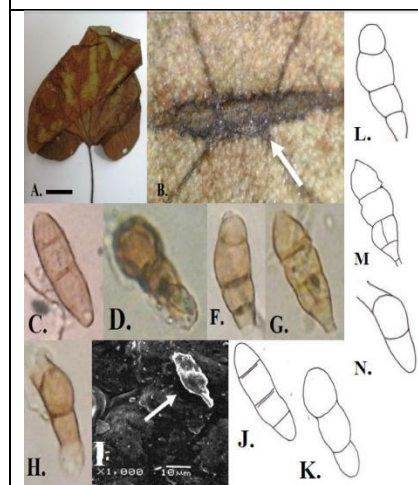


Plate 22: *Ipomoea batatas* A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Curvularia* sp. D-G. Microscopic photograph of conidia of *Alternaria alternata*; F, H. Microscopic photograph of conidia of *C. lunata*; I. SEM of conidia of *A. alternata*; J. Illustration of conidia of *C. sp.* K, M. Illustration of conidia of *A. alternata*; L, N. Illustration of conidia of *C. lunata*; Scale Bar (1cm) A= 1.8cm; B= 0.08cm; C= 4.7µm; D= 4.6µm; F= 4.9µm; G= 3.42µm; H= 4.9µm; J= 4.0µm; K= 4.9µm; L= 4.9µm; M= 4.03µm; N= 5.55µm

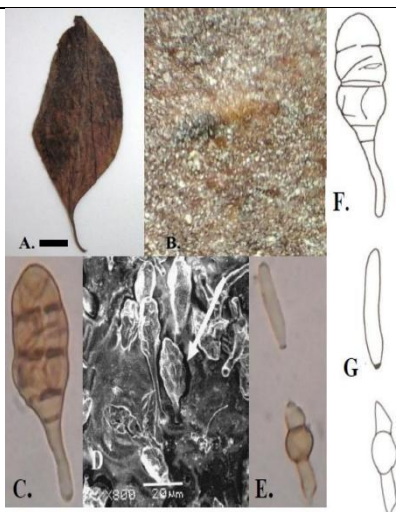


Plate 23: *Jatropha integerrima* A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria alternata*; D. SEM of conidia of *A. alternata*; E. Conidia of *Cladosporium cladosporioides*; F. Illustration of *A. alternata*; G. Illustration of *C. cladosporioides*; Scale Bar (1cm) A= 1.2cm; B= 0.1cm; C= 3µm; E= 7.0µm; F= 4.7µm; G= 5.3µm

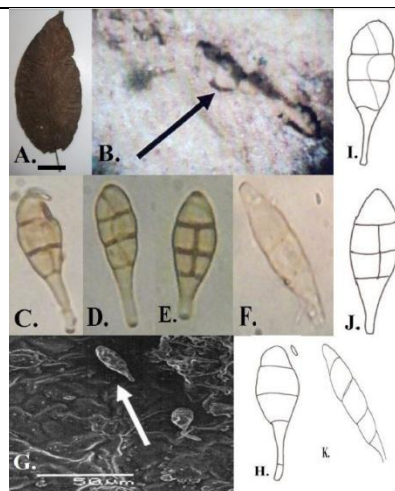
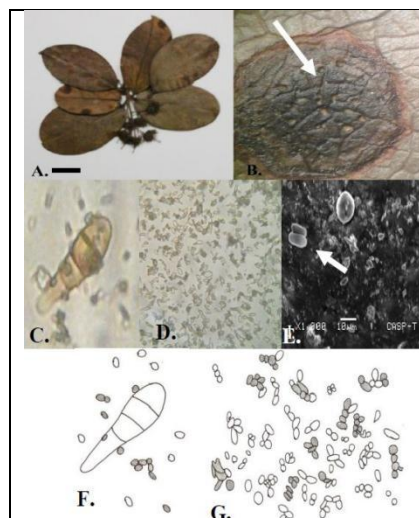


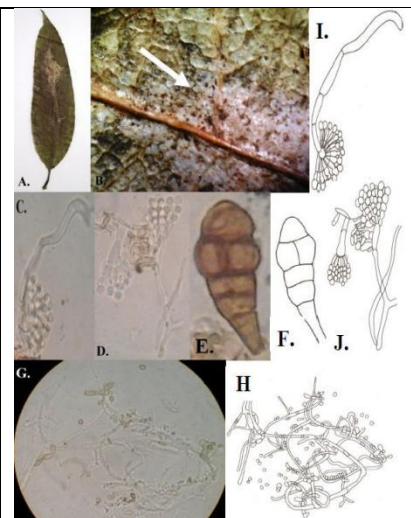
Plate 24: *Justicia adhatoda* A. Infected Leaf; B. Infection Site; C-E. Microscopic photograph of *Alternaria alternata*; F. Microscopic photograph of conidia of *A. sp.* G. SEM of conidia of *A. alternata*; H-J. Illustration of Conidia of *A. alternata*; K. Illustration of *A. sp.* Scale Bar (1cm) A= 1.4cm; B= 0.14cm; C= 3.12µm; D= 3.2µm; E= 4.5µm; F= 5.23µm; H= 3.4µm; I= 3.12µm; J= 3.2µm; K= 7.7µm



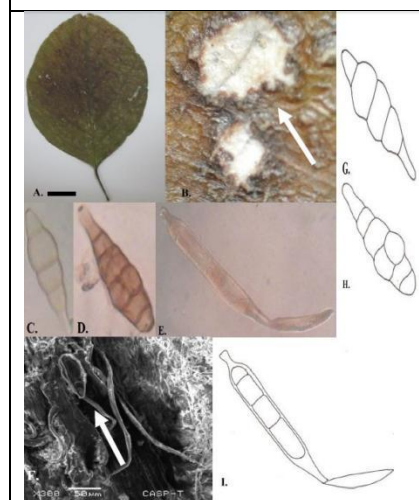
**Plate 25: *Lagerstroemia indica*** A. Infected Leaves; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria alternata*; D. Conidia of *Cladosporium cladosporioides* E. SEM of *C. cladosporioides*; F. Illustration of *A. alternata*; G. Illustration of *C. cladosporioides*; Scale Bar (1cm) A= 0.9cm; B= 0.12cm; C= 7.3µm; D= 0.5µm; F= 2.56µm; G= 1.01µm



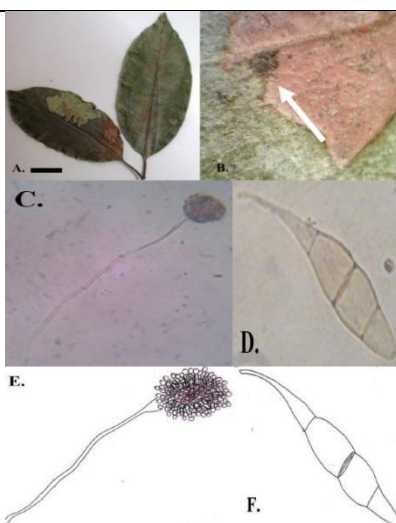
**Plate 26: *Lagerstroemia speciosa*** A. Infected Leaves; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria alternata*; D. Illustration of conidia of *A. alternata*; E. SEM of conidia of *A. alternata*; Scale Bar (1cm) A= 2.7cm; B= 0.3cm; C= 6.64µm; D= 6.9µm



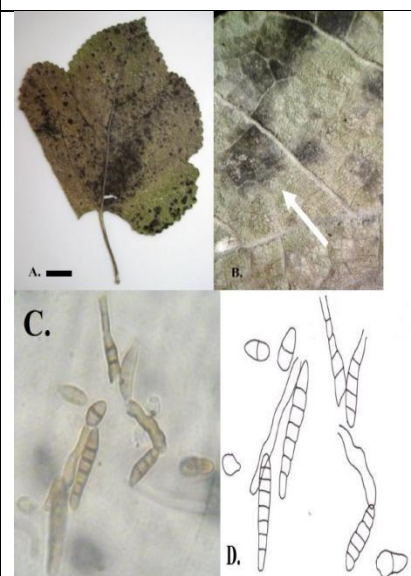
**Plate 27: *Mangifera indica*** A. Infected Leaf; B. Infection Site; C, D. *Aspergillus* sp. E. Conidia of *Alternaria alternata*; F. Illustration of *A. alternata*; G. *Cladosporium cladosporioides*; H. Illustration of *C. cladosporioides*; I, J. Illustration of *Aspergillus* sp. Scale Bar (1cm) A= 1.60cm; B= 0.2cm; C= 41.6µm; D= 43.91µm; E= 2.34µm; F= 4.0µm; G= 52.83µm; H= 44.21µm; I= 47.93µm; J= 43.91µm



**Plate 28: *Millettia pinnata*** A. Infected Leaf; B. Infection Site; C. Conidia of *Alternaria* sp. D. Conidia of *Alternaria alternata*; E. Unidentified sp. F. SEM of Conidia of *A. alternata*; G. Illustration of conidia of *A. sp.* H. Illustration of conidia of *A. alternata*; I. Illustration of unidentified sp. Scale Bar (1cm) A= 1.2cm; B= 0.09cm; C= 3.70µm; D= 3.23µm; E= 6.3µm; G= 3.20µm; H= 4.7µm; I= 6.10µm



**Plate 29: *Mimosa elengi*** A. Infected Leaves; B. Infection Site; C. *Aspergillus niger*; D. Conidia of *Alternaria* sp. E. Illustration of *Aspergillus* sp. F. Illustration of Conidia of *A. sp.* Scale Bar (1cm) A= 1.4cm; B= 0.3cm; C= 16.07µm; D= 4.36µm; E= 16.89µm; F= 4.31µm



**Plate 30: *Morus alba*** A. Infected Leaf; B. Infection Site; C. Microscopic photograph of conidia of *Alternaria* sp. D. Illustration of *A. sp.* Scale Bar (1cm) A= 1.2cm; B= 0.3cm; C= 14.5µm; D= 8.2µm

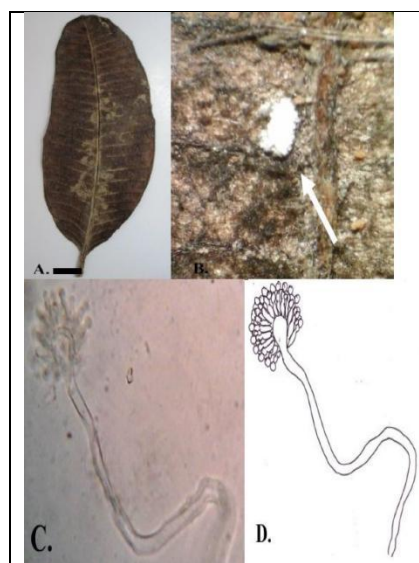


Plate 31: *Plumeria obtusa*. A. Infected Leaf; B. Infected Site; C. Microscopic photograph of *Aspergillus* sp. D. Illustration of *Aspergillus* sp. Scale Bar (1cm) A= 1.5cm; B= 0.1cm; C= 12.71µm; D= 13.14µm

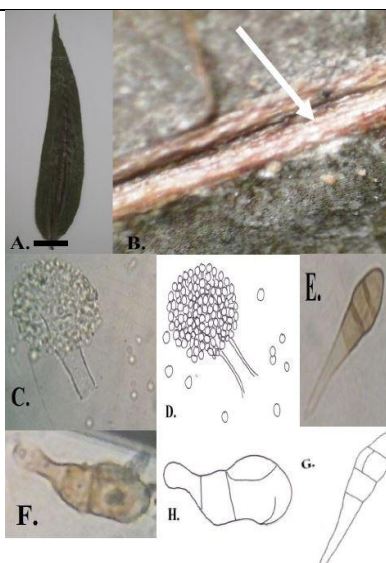


Plate 32: *Polyalthia longifolia*. A. Infected Leaf; B. Infection Site; C. *Aspergillus* sp. D. Illustration of *Aspergillus* sp. E, F. Conidia of *Alternaria alternata*; G, H. Illustration of *A. alternata* Scale Bar (1cm) A= 2.3cm; B= 0.2cm; C= 8.58µm; D= 9.71µm; E= 7.4µm; F= 8.68µm; G= 7.4µm; H= 8.4µm

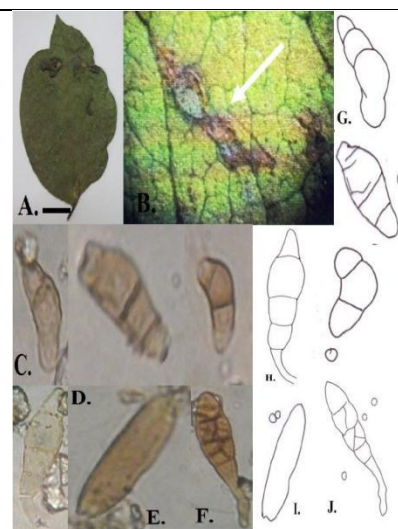


Plate 33: *Pongamia* sp. A. Infected Leaf; B. Infection Site; C. Microscopic photograph of Conidia of *Curvularia lunata*; D. Conidia of *Alternaria* sp. E. Conidia of *Curvularia* sp. F. Conidia of *Alternaria alternata*; G. Illustration of conidia of *C. lunata*; H. Illustration of *A. sp.* I. Illustration of conidia *C. sp.* J. Illustration of *A. alternata* Scale Bar (1cm) A= 1.4cm; B= 0.1cm; C= 4.1µm; D= 8.86µm; E= 3.31µm; F= 8.72µm; G= 5.65µm; H= 7.4µm; I= 5.5µm; J= 7.47µm

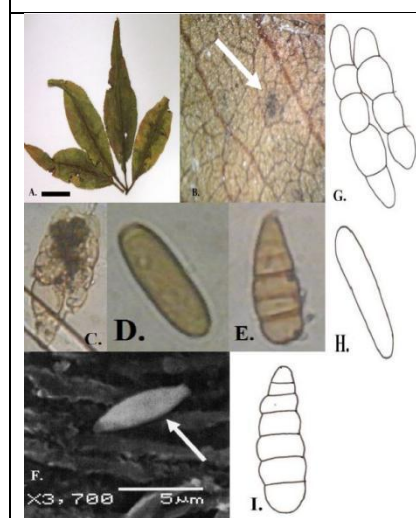


Plate 34: *Prunus armeniaca* A. Infected Leaves; B. Infection Site; C, E. Conidia of *Alternaria* sp. D. Conidia of *Curvularia* sp. F. SEM of Conidia of *Cladosporium cladosporioides*; G, I. Illustration of conidia of *A. sp.* H. Illustration of conidia of *C. sp.* Scale Bar (1cm) A= 1.3cm; B= 0.6cm; C= 4.29µm; D= 3.28µm; E= 4.29µm; G= 2.83µm; H= 4.54µm; I= 4.64µm

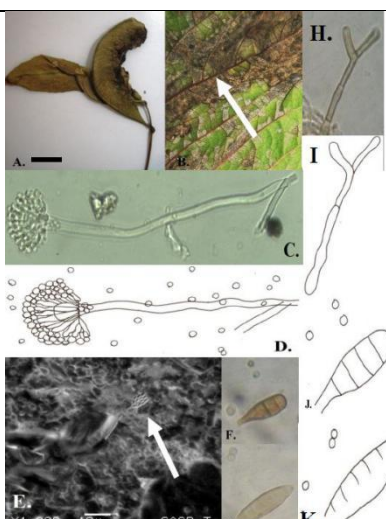


Plate 35: *Senna surattensis* A. Infected Leaf; B. Infection Site; C. *Aspergillus* sp. D. Illustration of *A. sp.* E. SEM of *A. sp.* F. Conidia of *Alternaria alternata*; G. Conidia of *Curvularia* sp. H. Conidiophore of *A. alternata*; I. Illustration of conidiophore of *A. alternata*; J. Illustration of Conidia *A. alternata* K. Illustration of conidiophore of *Curvularia* sp. Scale Bar (1cm) A= 1.4cm; B= 0.4cm; C= 14.22µm; D= 15µm; F= 9.8µm; G= 9.8µm; I= 4.5µm; J= 5.8µm; K= 45.40µm

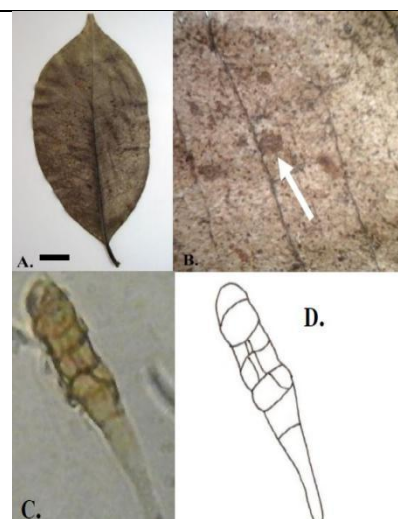
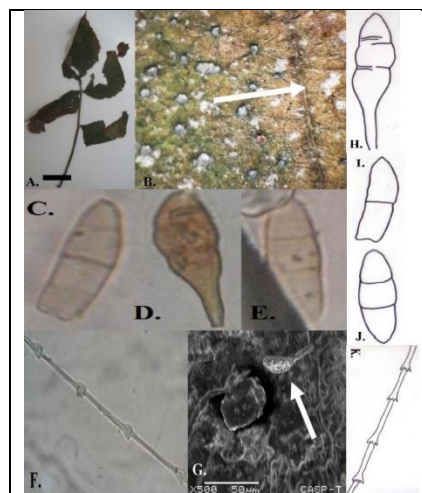
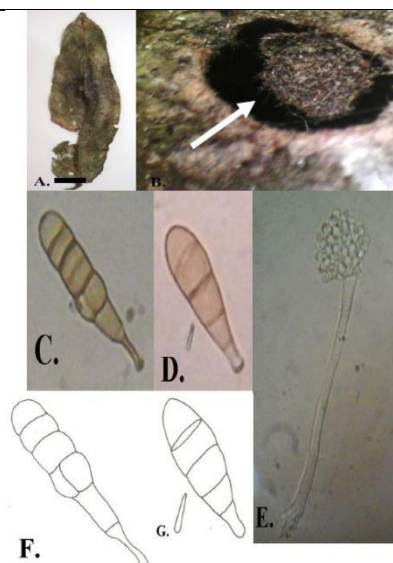


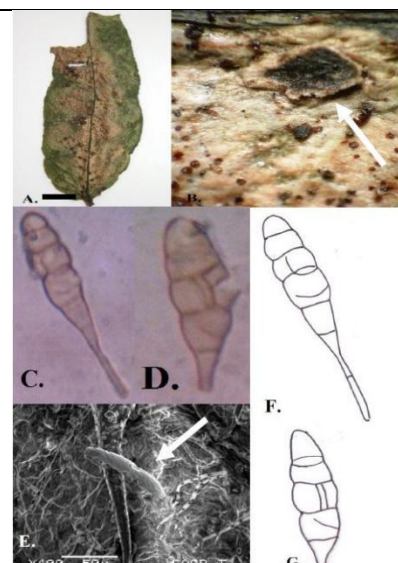
Plate 36: *Syzygium cumini* A. Infected Leaf; B. Infected Spot; C. Microscopic photograph of *Alternaria alternata*; D. Illustration of *Alternaria alternata*; Scale Bar (1cm) A= 1.6cm; B= 0.2cm; C= 5.64µm; D= 6.64µm



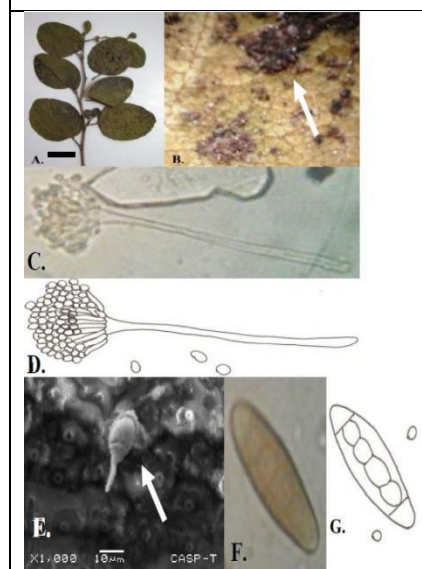
**Plate 37: *Tacoma stans*** A. Infected Leaf; B. Infection Site; C, E. Microscopic photograph of conidia of *Cladosporium cladosporioides*; D. *Alternaria alternata*; F. Unidentified sp. G. SEM of *Alternaria alternata*; H, I, J. Illustration of *Alternaria alternata*; K. Illustration of *Cladosporium cladosporioides*; Scale Bar (1cm): A= 2.8cm; B=0.3cm; C= 0.33µm; D= 3.32µm; E= 0.33µm; F=6.28µm; H= 3.56µm; I= 0.50µm; J= 0.56µm; K=9.96µm



**Plate 38: *Terminalia arjuna*** A. Infected Leaf; B. Infection Site; C. *Alternaria* sp.; D. *Alternaria alternata*; E. *Aspergillus* sp. F. Illustration of *Alternaria* sp.; G. Illustration of *Alternaria alternata*; Scale Bar (1cm): A= 2.1cm; B= 0.05cm; C= 6.52µm; D= 4.87µm; E= 10.02µm; F= 5.85µm; G= 4.87µm



**Plate 39: *Terminalia chebula*** A. Infected Leaf; B. Infected Site; C. *Alternaria* sp. D. Conidium of *A. alternata*; E. SEM of *A. alternata*; F. Illustration of *A. sp.* G. Illustration of *A. alternata*; Scale Bar (1cm): A= 1.7cm; B= 0.2cm; C= 5.19µm; D=3.12µm; F= 5.70µm; G= 3.7µm



**Plate 40: *Ziziphus jujuba*** A. Infected Leaf; B. Infection Site; C. Microscopic photo of *Aspergillus* sp. D. Illustration of *Aspergillus* sp. E. SEM of *Alternaria alternata*; F. Conidia of *Curvularia*; G. Illustration of conidia of *Curvularia*; Scale Bar (1cm): A=2.7cm; B= 0.14cm; C= 12µm; D= 12.40µm F=4.87µm; G= 4.41µm

*Cladosporium cladosporioides* was observed on the leaf surface of *Alternanthera ficoidea* and is characterized morpho-anatomically. *A. ficoidea* is native to Mexico, South America. It is cultivated in Lahore as an ornamental plant (Online Source 2). No previous report found about the existence of any kind of phylloplane mycoflora on this plant.

*Alternaria alternata* and *Cladosporium cladosporioides* were observed on the leaf surface of *Bauhinia variegata* and characterized morpho-anatomically in the present research. Valarini et al., (2007) studied the leaf yeast populations by using the spore-fall method from the phyllosphere of the *B. forticata*. Same taxa (*Alternaria alternata* and *Cladosporium cladosporioides*) were observed on the leaf surface of *Broussonetia papyrifera*. *B. papyrifera* is native of Japan, China and South east Asia; introduced and cultivated in Russia, Indo-Pakistan subcontinent, West Asia, tropical Africa, Europe, Polynesia, Philippines, U.S.A. and many other countries as an avenue tree (Online Source 3).

On the leaf surface of *Bursera serrata*, *Curvularia lunata* and some tentative species in-addition to *Alternaria alternata*, *Cladosporium cladosporioides*, were observed. *B. serrata* is native of E. Pakistan and Assam and cultivated in Lahore (Online Source 4). No previous reports were found regarding any kind of phylloplane mycoflora from Pakistan.

On the leaf surface of *Cassia* sp., *Aspergillus* sp. and *Cladosporium cladosporioides* were observed and characterized. *Alternaria alternata*, *C. cladosporioides* and *Curvularia* sp., were also observed on leaf surface of *Cassia fistula*, characterized morpho-anatomically. On the work of Limtong and Koowadjanakul (2012) in Thailand, 2 fungal species isolated from *Cassia fistula* were *Candida etchellsii* (Lodder & Kreger-van Rij) S.A. Mey. & Yarrow, and *Aureobasidium pullulans* (de Bary & Löwenthal) G. Arnaud.

In current study, *Alternaria alternata*, *Curvularia lunata* were also observed on the leaf surface of *Causonia* sp. and characterized morpho-anatomically. No previous reports were found about the existence of any kind of phylloplane mycoflora on this plant.

In the present survey, *Alternaria alternata* and *Alternaria* sp. were observed on the leaf surface of *Chrysanthemum indicum* and characterized. *C. indicum* is native to Asia and northeastern Europe and distributed to southern China (Liu et al., 2012). No previous report was found about the existence of any

kind of phylloplane mycoflora.

*Combretum indicum* is native to tropical Asia and widely cultivated throughout the tropics and subtropics, mainly as an ornamental plant, and has become naturalized in many localities (Online Source 5). In the present search, only *Alternaria* sp. was observed on leaf surface of *Combretum indicum* and characterized. No previous report was found about the existence of any kind of phylloplane myco-flora from Pakistan.

In the present investigation, *Alternaria alternata*, *Curvularia lunata* and tentatively identified sp. were observed on leaf surface of *Diospyros kaki* and characterized morpho-anatomically. *D. kaki* is introduced and cultivated throughout Eastern Asia, USSR, Japan and China (Online Source 6). No previous report was found about the existence of any kind of phylloplane mycoflora.

In the present study, *Alternaria alternata* and *Curvularia lunata* were observed on the leaf surface of *Erythrina suberosa* and characterized morpho-anatomically. *E. suberosa* is commonly cultivated in Pakistan and India (Online Source 7). No previous report was found about the existence of any kind of phylloplane mycoflora from Pakistan on this tree.

In the present investigation, *Alternaria alternata*, *Aspergillus* sp., *Cladosporium cladosporioides* and *Curvularia* sp. and tentative sp. were observed on the leaf surface of *Ficus* sp., while *Alternaria brassicae*, *A. helianthi*, *Cladosporium cladosporioides*, *C. heterophragmatis*, *Curvularia lunata*, and *Curvularia* sp., were observed on the leaf of *F. elastica* and characterized.

In the present investigation, *Alternaria alternata* was observed on the leaf surface of *Ficus benghalensis* and characterized morpho-anatomically. However, *Alternaria alternata*, *A. brassicae*, *Cladosporium cladosporioides* and *Curvularia lunata* were observed on leaves surfaces of *F. racemosa* and characterized.

On the leaf surface of *Ficus religiosa*, *Alternaria alternata*, *A. helianthi*, *Aspergillus* sp., *Cladosporium cladosporioides* and *Curvularia lunata* were observed and characterized. Limtong and Koowadjanakul (2012) isolated *Curvularia tropicalis* from *F. religiosa* (Limtong and Koowadjanakul, 2012).

On the phylloplane of *Ficus virens*, *Alternaria alternata*, *Cladosporium cladosporioides*, *C. herbarum*, *Curvularia lunata* and *Curvularia* sp. were observed. Wang et al. (2008) collected the fallen leaves of *F.*

*altissima*, *F. virens*, *F. benjamina*, *F. fistulosa* and *F. semicordata*, in Chiang Mai Province in northern Thailand and examined for existence of fungi (Wang *et al.*, 2008).

*Curvularia* sp. was also found on leaf surface of *Heterophragma adenophyllum*. Khan and Kamal (1962) isolated a new species *Cladosporium heterophragmatis* S.A. Khan & M. Kama from the *Heterophragma adenophyllum* wallich ex. G. Don., and described the structure (Khan and Kamal, 1962).

Phylloplane of *Hibiscus rosa-sinensis* was observed and found the occurrence of only *Cladosporium cladosporioides* on leaf surface. Limtong and Koowadjanakul (2012) isolated fungal species from *H. rosa-sinensis*, i.e., *Candida glabrata* (Limtong and Koowadjanakul, 2012).

Leaf surfaces of *Ipomoea batatas* were investigated and found the existence of In the present investigation, *Alternaria alternata*, *Curvularia lunata* and *Curvularia* sp. *I. batatas* is an American root crop and grown throughout the tropical and subtropical regions of the world. It is commonly cultivated for the edible tubers (Online Source 8). No previous report was found on this plant about the existence of any kind of phylloplane mycoflora from Pakistan.

In the present investigation, *Alternaria alternata* and *Cladosporium cladosporioides* were observed on the leaf surface of *Jatropha integerrima* and characterized morpho-anatomically. Venkatesan (2013) studied the biodiversity of mycoflora associated with decomposing leaf litter of *Jatropha curcas* (Biodiesel plant) with the pattern of fungal colonization. A total of 79 fungal species belonging to 59 genera were isolated and 4 main groups of taxa were identified (Venkatesan, 2013).

*Alternaria alternata* was also observed on the leaf surface of *Justicia adhatoda* and characterized on the basis of microscopy. *J. adhatoda* is distributed in Panama (probably introduced), Indonesia, Malaya, S.E. Asia, India and Pakistan. In Pakistan, it does well on waste lands up to 1300 m; it is also cultivated as an ornamental in Lahore (Online Source 9).

In this study, on the leaf surface of *Lagerstroemia indica*, *Alternaria alternata* and *Cladosporium cladosporioides* were observed and identified. *L. indica* is extensively planted in the sub-continent (Online Source 10). No previous data was found about the existence of any kind of phylloplane mycoflora from Pakistan.

*Alternaria alternata* was observed on the leaf surface of *Lagerstroemia speciosa* and characterized morpho-anatomically. *L. speciosa* is native in Assam and South India and cultivated elsewhere (Online Source 11). This is the first report about the existence of any kind of phylloplane mycoflora from Pakistan on this host.

In the current investigation, *Alternaria alternata*, *Aspergillus* sp. and *Cladosporium cladosporioides* were observed on the leaf surface of *Mangifera indica*. This tree was observed by Limtong and Koowadjanakul (2012) and collected and evaluated 91 leaf samples from Thailand. Isolated species was *Hanseniaspora opuntiae* Čadež, Poot, Raspor & M.T. Sm. (Limtong and Koowadjanakul, 2012).

In the current investigation, *Alternaria alternata* and Tentatively identified fungal sp. were observed on leaf surface of *Millettia pinnata*, while *Alternaria alternata*, *Curvularia lunata*, and *Curvularia* sp. were observed on the leaf surface of *Pongamia* sp. and characterized morpho-anatomically. Ten new species of ascomycetes collected in Taiwan were described, illustrated and compared with closely related taxa by Hsieh *et al.* (1995), from which *Schizothyrium millettiae* Sivan. & W.H. Hsieh, was present on *Millettia nitida*.

On the phylloplane of *Morus alba* in this study, *Alternaria* sp. was identified. Previously from Pakistan, Abbas *et al.* (2010) reported 5 fungal species on *Morus alba* viz; *Tetracoccusporium aerium* P.C. Misra & P. Srivast., *Gliomastix novae-zelandiae* S. Hughes & C.H. Dickinson, *Septoria cytisi* Desm., *Pseudocercospora mori* (Hara) Deighton, and *Lasiodiplodia undulata* (Berk. & M.A. Curtis) Abbas, B. Sutton, Ghaffar & Abbas.

In this research, only *Aspergillus* sp. was observed on the leaf surface of *Plumeria obtusa* and characterized morpho-anatomically. Previously, two fungal species were isolated from *Plumeria* sp. during the work of Limtong and Koowadjanakul (2012) viz. *Candida tropicalis* (Castell.) Berkhout and *Starmerella meliponinorum* A.C.P. Teixeira, M.M. Marini, Lachance & C.A. Rosa.

In this research, *Alternaria alternata* and *Aspergillus* sp. were observed on leaves surfaces of *Polyalthia longifolia*. *P. longifolia* is distributed in Indigenous to Sri Lanka, cultivated in India, Malaya, Pakistan and Tropical East Africa. The Mast Tree is indigenous to Sri Lanka, elsewhere it is cultivated. In Pakistan, it is commonly cultivated in Sindh as an avenue tree or in gardens, also occasionally planted in

Punjab. It rarely flowers in Karachi (Online Source 12). No previous data about the existence of any kind of phylloplane mycoflora on this host plant was reported.

In the current study, *Alternaria* sp., *Cladosporium cladosporioides* and *Curvularia* sp. were observed on the leaf surface of *Prunus armeniaca* and characterized morpho-anatomically.

In the present investigation, *Alternaria alternata*, *Aspergillus* sp. and *Curvularia* sp. were observed on the leaf surface of *Senna surattensis*. *S. surattensis* origin remains obscure. It was previously thought by Benthham to be native to coastal north Australia and often cultivated as an ornamental, in many tropical and subtropical regions including Southeast Asia, Africa, and the West Indies, and is known to have escaped into the wild, naturalizing in many of these places (Online Source 13).

Two species of *Alternaria* such as *A. alternata* and *A. brassicae* were observed on the leaf surface of *Syzygium cumini* and characterized morpho-anatomically. Sudheep and Sridhar (2010) collected the canopy samples such as trapped leaf litter, trapped sediment, stemflow and through fall from Kaiga forest India to evaluate the occurrence of water-borne hyphomycetes.

In the present investigation, *Alternaria alternata*, *Cladosporium cladosporioides* and Tentatively identified fungal sp. were observed on the leaf surface of *Tecoma stans*. *T. stans*, a native of tropical South America, is widely cultivated in the tropics and subtropics (Online Source 14). *Alternaria alternata*, *A. brassicae* and *Aspergillus* sp. were isolated from *Terminalia arjuna* while *Alternaria alternata* and *A. brassicae* were isolated from *T. chebula* and characterized. Valarini et al. (2007) studied the leaf yeast populations from the phyllosphere of the *T. catappa* by using the spore-fall method. A small subset of isolated fungi was *Aureobasidium pullulans* (de Bary & Löwenthal) G. Arnaud, *Pseudozyma antarctica* (Goto, Sugiy. & Iizuka) Boekhout, *Cryptococcus albidus* (Saito) C.E. Skinner, *Candida guilliermondii* (Castell.) Langeron & Guerra, and *Candida* sp.

On the leaf surface of *Ziziphus jujuba*, *Aspergillus* sp., *Cladosporium cladosporioides*, and *Curvularia* sp. were observed and characterized. Limtong and Koowadjanakul (2012) worked on *Z. mauritiana* and isolated *C. tropicalis* and *Pichia kudriavzevii* Boidin, Pignal & Besson, fungal species.

Percentage abundance of mycoflora on each family was following: Fabaceae (57.5%), Apocynaceae

(7.5%), Moraceae (65%), Lythraceae (7.5%), Bignoniaceae (10%), Combretaceae (15%), Amaranthaceae (2.5%), Burseraceae (10%), Cucurbitaceae (7.5%), Asteraceae (5%), Ebenaceae (10%), Malvaceae (2.5%), Convolvulaceae (7.5%), Euphorbiaceae (5%), Acanthaceae (5%), Anacardiaceae (7.5%), Sapotaceae (5%), Annonaceae (5%), Rosaceae (7.5%), Myrtaceae (2.5%), Rhamnaceae (7.5%).

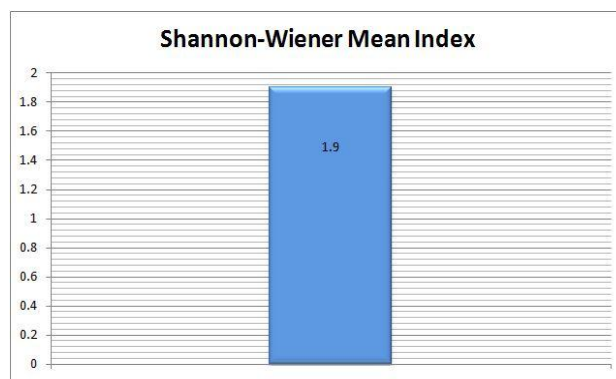
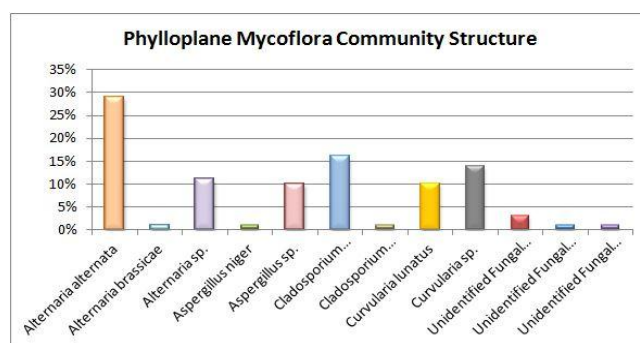
The relative abundance of mycota (Simpson's Index) on 40 plants is 0.15 whereas the species diversity (Shannon Weiner's Index) on 40 plants is 1.9. *Alternaria alternata* had the highest abundance ratio and *Cladosporium cladosporioides* had the second highest abundance rate. So, we concluded that *Alternaria alternata* and *Cladosporium cladosporioides* were found to be dominant on the leaves of selected trees.

**Calculation of Species Richness and Diversity for Phylloplane Fungi (Tables 2 & 3; Figures 1 & 2):** Species Richness and Diversity for phylloplane fungi was calculated by Simpson's Index and (D) Shannon-Wiener Index (H).

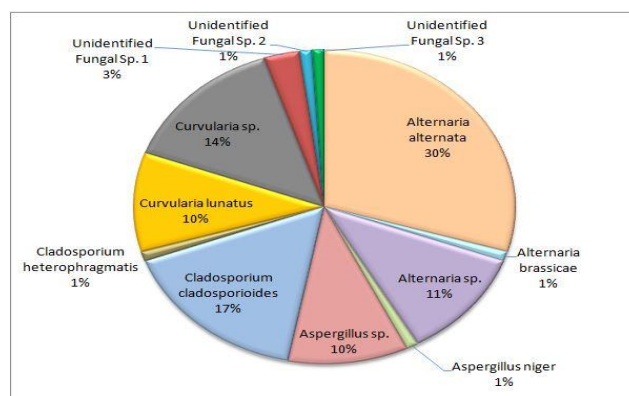
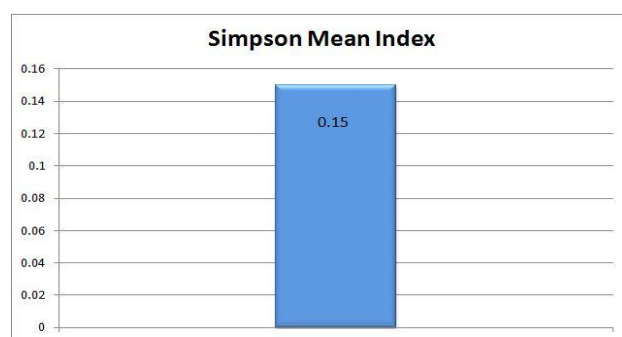
| Simpson Index                                                                                                                                                                                                                                                                                                                                                                                                                                      | Shannon- Wiener Index                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases. The value of Simpson Index ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity so more the value of D, the lower the diversity.</p> $D = \frac{\sum n(n-1)}{N(N-1)}$ | <p>This diversity measure came from information theory and measures the order (or disorder) observed within a particular system. This order is characterized by the number of individuals observed for each species in the sample plot. The value of Shannon- Wiener Index ranges between 1 and 5. With this index, 1 represents low species richness and 5 represents high species richness. It increases as diversity increases.</p> $H = \sum_{i=1}^s - (P_i \times \ln P_i)$ |

**Table 2: Species Richness and Diversity of Phylloplane Fungi**

| Species Name                         | Observed Abundance | Percentage Abundance |
|--------------------------------------|--------------------|----------------------|
| <i>Alternaria alternata</i>          | 25                 | 29%                  |
| <i>Alternaria brassicae</i>          | 1                  | 1%                   |
| <i>Alternaria</i> sp.                | 10                 | 11%                  |
| <i>Aspergillus niger</i>             | 1                  | 1%                   |
| <i>Aspergillus</i> sp.               | 9                  | 10%                  |
| <i>Cladosporium cladosporioides</i>  | 14                 | 16%                  |
| <i>Cladosporium heterophragmatis</i> | 1                  | 1%                   |
| <i>Curvularia lunata</i>             | 9                  | 10%                  |
| <i>Curvularia</i> sp.                | 12                 | 14%                  |
| Unidentified Fungal Species 1        | 3                  | 3%                   |
| Unidentified Fungal Species 2        | 1                  | 1%                   |
| Unidentified Fungal Species 3        | 1                  | 1%                   |

**Species Belonging to Phylloplane Fungi****Fig. 1 Species Abundance Bar Graph****Table 3: Percentage Abundance of Different**

| Total No. of Trees | Total No. of Fungal Species | Alpha Biodiversity |                                    |                                  |                          |
|--------------------|-----------------------------|--------------------|------------------------------------|----------------------------------|--------------------------|
|                    |                             | Simpson Index      | Simpson's Index of Diversity (1-D) | Simpson's Reciprocal Index (1/D) | Shannon Wiener Index (H) |
| 40                 | 12                          | 0.15               | 0.85                               | 7.77                             | 1.9                      |

**Fig. 2 Community Structure Pi Graph**

## Conclusion

Here we present the morpho-anatomical, species richness and abundance data of filamentous and yeast fungal myco-biota that occurred on the phylloplane of selected tree species growing in Mall Road Lahore. A total of 40 tree species were analyzed and investigated for the diversity of myco-flora, using conventional morphological and microscopic tools. Among all the isolated fungal strains, *Alternaria alternata*

and *Cladosporium cladosporioides* were the dominant fungal species of phylloplane in current study.

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