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Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

A Report for Phylloplane Myco-diversity : Minireview

Jagiya A. A , Zingare A. K, Kawale M. V.*
Department of Botany,
M.B. Patel College, Sakoli, D. B. Science College, Gondia*
Mail: amitjagiya@gmail.com

Abstract:

Phylloplane, landing tribunes for mycobiota,is the surface of plant leaves reprsents complex terrestrial habitat, characterized by a variety of microorganisms.Majority of the phylloplane microbiota constitutes yeasts and filamentous fungi. Investigation of plant-phyllofungi interdependence, is an approach offers a unique corelation to survive and thrive. Seasonal changes, host species-specific trichomes, hairs, glands and other laminar surface attributes provides unrevealed milieu of complex interactions with fungi. Phylloplane mycodiversity, is a knot of many complex interactions that need to untie, and is essential to understand. It comprises variety of niches and encloses package of plant growth and survival, also affect different components of ecosytem in the relative food chain. Phylloplane studies are in demand for the future of Phylloplane mycodiversity to isolate them and to evaluate their intimate relationship.

Keywords: Phylloplane fungi, Mycodiversity, Seasonal changes, Colonization

Introduction:

Biodiversity is the variation of life forms within a given ecosystem, and often used as a measure of the health of biological systems. Fungi, beingFascinating and vital components of nearly all ecosystems,interferes human health and economy in a various ways. Mycobiota and its diversity is necessary to investigate for collecting or monitoring the data as far as plant and human lives are concerned.Standardized methods for documenting mycodiversity and their distribution needs improvisation.(1)

Plants host diverse species composition of fungal microorganisms;some are beneficial and hence promote their growth, while others being plant pathogens, may develop the disease or even kill the host plant. Rests of the colonists, forms majority on the host plants, plays no significantrole on plant growth or function.An aerial surface of plant is a vital habitat for many micro-organisms, including bacteria, fungi andyeasts. Phyllosphere is a term, refers to the total aerial plant parts, especially three dimensional aspects of leaves.(2)Phylloplane on the other hand, best defined asmycota growing on the surface of leaves.Phylloplane exhibits a complex terrestrial habitat, andPhylloplane fungi represented byresidents and casuals. Residents can multiply on the surface of healthy leaves with no symptoms on host. Whereas, casuals land on the leaf surface but cannot grow.(3)

Phylloplane, being very richin nutrients, plays a needy role for the colonizationof various fungal species. Phylloplane fungal diversity are also influence by host leaf epidermal attributes including its size, stomatal index, density ofhairs and trichomes and architect of leaf surface; as well as host plant surroundings such astemperature, humidity, light intensity, presence of air pollutants.[4,5]
Mycodiversity of the epiphytic microbial population exhibits large range of fluctuations, that may depends on nature, age and physiology of host plant and their parts, seasonal changes, and diverse leaf surface habitat in terms of their morphological and physicochemical properties.[6,7].Phyllosphere, inhabits by many nonpathogenic fungi, moreover depends on nutrients exuded from laminar sufaceand on air depositions as well.[8]Major proportion of mycodiversity in andon the leaf routes from fungal propagules,fallen accidentally onto the leaf blade by air dispersal.Furthermore, host species-specific trichomes, hairs, glands and other laminar surface attributes provide a largelyunrevealedmilieu of complex interactions withfungi.[9]
Majority ofthe phylloplane microbiota constitutes yeasts and filamentous fungi. Filamentous fungi from the phylloplane are diverse in nature like parasites, saprophytes, endophytes orepiphytes.[10,11,12] Epiphytic fungi, without causing damage, exists on the leaf surfaces. While photosynthetic potential may get reduce, reported in some research.[13,14]Existance of positive or negative complex interactions between epiphytes and pathogenic microorganisms, may results in beneficial or harmful relationship. In contrast to phytopathogens,fewphylloplanefungi protect host leaves against infections.[15,16,17]
Phylloplane mycodiversity,is a knot of many complex interactions that need to untie, and is essential to understand. It comprises variety of niches and encloses package of plant growth and survival, also affectdifferent components of ecosytemin the relative food chain. Phylloplane studies are in demand for the future of Plant-Mycodiversity interdependance.

Isolation Methods:

Healthy leaf samples ofselected plants werecollected from predefined sites, immediately put into sterile plastic bags, andbrought tothe laboratory for further processings. Different techniques were used and standardized by researchers depending on the target mycoflora. Isolation of leaf mycoflora techniques includes,Leaf imprinting[2], Leaf washings and serial dilution methods, Agar plate method (Leaf discs), Moist chamber methods[11,18,19,20] ; out of which agar plate (leaf disc) method is more commonly used.

In leaf disc method, washing leaves several times with sterile or double distilled water, followed by cutting them with the help of cork borer or scalpel, into equal segments (about $1cm^2$ each). Three - Five segments placed on the nutrient media specially made for fungal isolations. Each plate of the agar medium supplemented with desired antibacterial antibiotics, say Chloramphenicol(0.01%).

Different nutrient media used like, PDA, Czapek-Dox, Rose Bengal Agar. Later, plates incubated at 28^0C for a week. Fungal coloniesobserved for their identification and processed for maintenance of pure cultures. Depending on their growth, at least one isolate of each macro-morphologicaltypepicked for purification. Identificationoffungi done bystandard methods.

Phylloplane aslanding tribunes for mycobiotareservoir
Leaves of plant with spores and hyphae of fungi forms interkingdom runway, subject to the impact of range of abiotic factors and morpho-physiological changes in the aerial sufaces of plants.[14] Leaves provides variety ofpositive or negative modulators to regulate the fungal colonization.

Population dynamics on leaves in time and space area function of immigration, emigration, growthand death.[21] Phylloplane fungi considered to be potential sources of Bio-Control Agents (BCAs), as are capable to colonize on the target plant.[16]

Phylloplane mycodiversity intimately depends on several host attributes such as, nature, age and polarity of leaves, and epidermal architects and appendages as well. Yeasts, and filamentous fungi represents lower densities in juvenile and fresh, tender leaves and higher in mature leaf stage.Furthermore, imprinting leaves mostly resulted in higher densities and diversitiesadaxially, butcomparisions between abaxial andadaxial imprints are not always significant.[11]

Fungal spore existence on leaf surface and their colonization involves series of complex interactions, including leaf topology as an important factor. Cell wall acts as initial physico-chemical barrier [22,23]; Cuticle, being hydrophobic, infers resistance to plants and inhibits fungal growth[24,25]; Simple Non-glandular Trichomes, traps the fungal spores and do not allow them to reach the plane of lamina; Glandular trichomes are very complex, sometimes inhibits fungal colonization by secreting antimicrobial compounds, and in many cases, it facilitates the growth and penetration of fungal spore and hyphae, hence become preferred sites of colonization.[26,27]Trichomes, absorb ergot alkaloids from the epibiotic fungal species of the genus *Periglandula*, hence play dual and key function in a metabolic dialogue between fungus and host plant.[28]

Seasonal Changes and Phyllo-Fungal Diversity

Diversities and variation in number and species composition of Phylloplane fungi have correlation with seasonal changes and shifts in temperature,[22]spatial locations,[16] climate trends,[11,23,24,25]leaf ages and habits,[8, 23, 24] vegetative, flowering and/or harvesting phases.[11,14] So, climatic and biotic factors appeared to bevital factors contributing to seasonal changes in the succession of interior colonizers.[22,29]Frequency of phyllo-fungal species diverse significantly in wet and dry seasons, viz; low colonization in dry season and greater in wet. Dispersal of fungal spores enhanced due to greater rainfall in the wet seasons.[23, 24]

Number of isolates obtained from the paddy field in wet seasons (dominated by Epicoccum sp.) found to be four times more than in winter (dominated by Fusarium sp).[16]Seasonal trends in phyllo-fungal diversities represented elevation from winter to spring,followed by a slight decrease in summer and a rise during autumn. Yeast species compositions peaked during summer and declined to a lowest level in spring. In a broader concept, yeasts diversities found to be lower thanfilamentous fungi, which further were lower than bacteria.[11]Fungal population observed significantly higher during flowering stage followed by vegetative and harvesting phase.[14] Phylloplane mycodiversity represented elevation in winter (flowering phase), followed by a decline toward theend of the season in Mango. Preferably, flowering phase regarded as most active period of phylloplane communities, as liberation of large amounts of pollen propagules, serve as rich, exogenous source of nutrients for colonizers.[11]

Phylloplanedensities in number and species composition would bemorenumerous on theevergreens, with respect to theleaves longevity; on the contrary, overalldensitiesoffilamentous fungiforthe autumnsamplings ofthe deciduoustrees,werestatisticallyhigher than those for theevergreens. In few specialized plants, populationsofmycobiota becomeestablishedon the phylloplane of deciduous treesinarelativelyshort period(from springto autumn), alsoleaf

turnover,nutrientavailability,or otherintrinsic factors may affecton the populationlevels on theevergreens[30]Availability of nutrients, which is dependent on leaf age and growing conditions, can be of relevancefor the diversities of the yeast communities as well.[8,31, 32]

Phylloplane Mycodiversity :

Fungal diversity represented by 1.5 Million species[33], biogeographic distributions, levels of endemism, and host specificity are important aspects to consider for developing estimates of global fungal diversity.[34]Mycodiversity on aerial leaf surfaces on leafy vegetables, wild plants, and medicinal herbs shows huge variation in species compositions. Phylloplane studied extensively on wide range of plants, including herbs, shrubs and trees.

Filamentous fungal, and Yeast communities, on juvenile and mature leaves were more diverse than on foliole leaves (leaflets).Dominant member of the yeast population obtained fromFagus [30,35], Mango[11], Quercus and Acer species[10]was*Aureobasidium pullulans*,followed by*Sporobolomyces roseus*.[11]Basidiomycetous yeasts found to bemore dominant than that of Ascomycetous,as confirmed on Maize and Sugarcane phylloplane.[36, 37]

Diversities in range of filamentous fungiisolates was obtained from different species, as highest isolates from*Quercus robur*(20%) followed by moderate values from *Q. pubescens, Q. rubra,Q. petraea,Acer platanoides*, and *A. pseudoplatanus* (12 - 17%),*Acer campestre*had the lowest numberof isolates (9%).[10]

*Epicoccum sp.*were the most prevalent fungi (34%), subsequently common members include *Cladosporium* and *Pestalotiopsis*(26% and 17%, respectively), andfew were obtained less frequentlylikeFusarium, Macrophoma, Volutella, Penicillium andTrichoderma, isolated from Rice phylloplane.[16, 38]Predominantlycolonizing species, obtained from one most economically important crop, Wheat representedCladosporium, Aspergillus, Alternaria,Epicoccum,[39]along with few most common phylloplanegenera asStemphilum, Penicllium, Ulocladium, Nigrospora, and Torula.[40]

Filamentous fungi isolatedfrom mango leaves comprised mainly hyphomycetes, as on other perennials (Acer, Ilex, Malus species) and annuals (Sugarbeet leaves). Cladosporium. cladosporioides and Alternaria alternata were most prevalent filamentous fungi[2,9]found in different sampling times, andhas been reportedfor several plant species (Pinus, Halimiton, Barley, Canberry, Mangifera, Sugarbeet, Ocimum, Phyllanthus, Azadirachta, Tinospora). The dominance and persistence of Aspergillus, Cladosporium and Alternaria is attributed to their excellentadaptation on leaf surfaces.[3,11,18,19]Microbial isolates,Rhodotorula sp, Saccharomyces sp, and Aspergillussp,were more frequent andfound uniformly onOkra leaves.[12,14]In Fagus plant, commoninhabitants of thephylloplane,such asCladosporium sphaerospermum,Trichodermaharzianum, Penicillium brevicompactum, were also foundto occur withhigh frequencies.[30 , 35]

Phylloplane fungi were isolated from the medicinal plants viz, *Ocimum sanctumm Phyllanthus amarus Azadirachta indica* by dilution plating technique,as*Aspergillus flavus, Penicillium expansum, Fusarium semitectum, Fusarium oxysporum* in the phylloplane of *Ocimum sanctum*; Scopulariopsis sp. from the phylloplane of*Phyllanthus amarus*; and*Penicillium janthinellum, Aspergillus fumiculosis, Curvularia lunata and Fusarium moniliforme*wereisolatedfrom*Azadirachta indica*[3]

Most reports of phylloplane fungi,validates marked dominance of anamorphicfungi, mostlyof ascomycetousaffinity, only occasional coloniesof basidiomycetous and zygomycetous microfungihave been observed.[18,30,33,34,38]

Conclusions :

Fungi represents broad range from, exclusively- ectophyticoccurrence on the leaf, partly- internal and external growth, to exclusively- endophytic life. Phylloplanemycodiversity emphasize on the internal fungal colonizers, without developing any external symptoms. Microbes colonizing the inner plant tissues have beneficial traits, which may contribute to produce a large variety of bioactive compounds that mightplay a role in biocontrol and plant growth promotion.As discussed in this mini-review, different plant speciesmayrepresentsfew new fungal isolates, and many already reported common phylloplane fungi.

Furtherstudies on the isolation and identification of fungi, as well as investigating anddocumentingtheir complex ecological roles on aerial leaf surfaceshelps to reveal hidden information in partially opened book. Fungiisolatedfrommedicinal and crop plants habitually expressnovelandimportantbiologicalactivities.Documenting thespecies compositionof phylloplane myco-diversityexistingovertheworldand comparing this informationmaycontributein understanding the complex interaction and corelationbetweenmicrobes and manyother dependant factors.

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