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Review Article

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Bambusicolous Fungi: A Reviewed Documentation

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ABSTRACT

Bamboo together with Bambusicolous fungi are cosmopolitan recorded abundantly from China and Japan in Asia, but fewer in India and South America. 290 species of Bamboo fungi revealed from tropical region while 690 species were recorded from temperate region. Bambusa, Phyllostachys, Sasa and Arundinaria are the main substrate which gives rich yield of fungi. Fungi included under various taxa such as Hyphomycetes, Basidiomycetes, Ascomycetes and Coelomycetes. Endophytes as well as pathogens have also been reviewed and recorded Bamboo fungi traditionally used as medicine and have edible value in China.

Keywords: *Bamboo, Diversity, Pathogens, Fungi, Species*

INTRODUCTION

World's most important agricultural plant is 'Grass'[1] include cereals, sugarcane and forage grasses for farm animals, ornamental grasses and bamboos, each has a significant role in welfare. Bamboos are important to conserve and manage forest, such as reduction of soil erosion and also important to Panda conservation[1] and many more commercial application as-fishing rod, flute, paper, flouring material, food and energy feed stock. The largest flowering plant family which ranked third in number of genera (ca. 600) and fifth in number of species (ca.7, 500) is Poaceae[2]. Bamboo belongs in the Poaceae (Gramineae) and form tribe bambuseae of the subfamily bambusoideae [3,4].

There are an estimated 1000 species of bamboo under 80 genera worldwide, and about 200 species are found in South-East Asia[3]. Bamboo occurs all around the world such as in tropical, subtropical, and temperate regions of all continents, but limitedly occurred in Europe which has no native species.

The genera of bamboo vary in habit. Some are clump forming or single-stemmed. They may be erect with drooping or pendulous tips, or slender and scrambling, or climbing. The main parts are the rhizome, shoot, culm, leaf, branch, leaf, inflorescence and fruit. Their rhizome and branching systems, the presence or absence of bristles or hairs on the culms and culms sheaths, and structures of the inflorescences distinguish the genera of bamboo from each other.

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Bamboo/Bambusicolous Fungi:

In ancient period, the Bamboo fungi was termed as 'fungorum bambusicolorum' (Bambusicolous fungi) by[5] which means 'living on bamboo'. Hyde[6] revealed that Bambusicolous included all fungi that grow on bamboo substrates, leaves, culms, branches, rhizomes and roots and enlisted more than 1,100 species that lived on bamboo worldwide including 630 ascomycetes, 150 basidiomycetes and 330 anamorphic fungi that an incomplete and still at the cataloguing stage. According to literature search and scanning the 'Index of Fungi'.

Kuai[7] reported 190 pathogenic bambusicolous fungi in Mainland China and Taiwan whereas Zhou[8] reviewed 189 species belonging to 75 genera of bamboo fungi from main land China and 79 species of 58 genera from Hong Kong. Statistical analysis on fungi resulted 183 species of pathogenic fungi on bamboo in China, included 85 species from 58 genera of ascomycetes, 48 species from 58 genera of basidiomycetes and 50 species from 29 genera of hyphomycetes. In Japan 307 species (Ascomycota 63%; Basidiomycota 10%; anamorphic fungi 27%) fewer than 86 bamboo taxa was reported[9]. Boa[10,11] studied on pathogenic fungi while Eriksson and Yue[12] re-examined all ascomycetes described as new species from bamboo. Due to unavailability of comprehensive review of the literature on bamboo fungi so that, this paper attempt to provide a general spectral review.

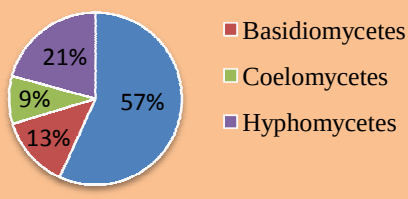
Geographical Distribution of Bambusicolous fungi:

Bamboos are highly diverse and are distributed throughout Asia, especially in China and Japan. The high number of Bambusicolous fungi may be attributed to the high diversity of bamboo[6] in several region of China[13]. China is hot spot for bamboo as well as Bambusicolous fungi. World's one third bamboo forest occupied in China i.e., about 7.2 million hectare which is mainly distributed in Anhui, Zhejiang, Fujian, Taiwan, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Guangdong, Guangxi, Guizhou and Yunnan regions[14]. Yunnan has the richest bamboo diversity in Asia with 210 woody bamboo species under 28 genera[15] and Taiwan has about 50 bamboo species under 9 genera[16,17]. The majority of species from South America were recorded from Brazil (59% of the total collections) by C. Spegazzini, P. Hennings and F. MalleI. Forty-four genera (60% of the world's total number) of bamboo occur throughout tropical, subtropical and temperate Asia. There are more than 290 and 690 species of fungi recorded from the tropics and temperate regions, respectively. This enormous diversity of plant species in an area is likely to support an equally diverse mycota.

There have been some taxonomic/ecological studies on bamboo fungi, but these are limited to particular localities such as France[18] Hong Kong[6,19], Japan[20] and the Philippines[21-27]. Bamboo occurs along the banks of many streams and rivers in the tropics. The fungi on submerged bamboo are also more diverse, and in general differ from those on submerged wood[28,29].

A review of various literature (Table: 1) reveals more than 1100 species of fungi have been recorded from bamboo which comprises more than 630 ascomycetes, 150 basidiomycetes and 330 mitosporic taxa 100 coelomycetes and 230 hyphomycetes[6,10-12,18-27,30-33].

Table : 1
A Reviewed Diversity of Bambusicolous Fungi in the World



Historical aspects and Diversity Calibration:

At the first time[34] described Dothideagoudotii Lev. and Sphaeria bambusae Lev. Fungi. Globally Arundinaria, Bambusa, Phyllostachys and Sasa genera of bamboo have recorded highest numbers of fungi out of which species of Bambusa in particular have been found to support a high fungal diversity, as it is one of the most widespread genera in tropical and subtropical Asia[3] having a large number of species. It may also be due to mycologists use Bambusa as a general term for bamboo. There are more genera of bamboo occurring in tropical regions, and yet more fungi are known in the temperate regions[35].

Table 2: Historical aspects of Bambusicolous fungi shown below

Bambusicolous fungi species	Year	Bamboo species	Reference
Dothideagoudotii Lev.	1845	leaves of Chusquea species	[34]
Sphaeriabambusae Lev.	----------	Culms of Bambusaarundinacea.	---------
Asterinamicroscopica Lev.	1846	leaves of Chusquea species	[36]
Sphaeriahypoxantha Lev.	----------	Culms of Bambusaarundinacea	
Sphaeriafusariispora	1854-1856	Bambusa species	[37-39]
Hypoxylonfuscopurpureum (Schwein.) Berk.	---------	Phyllostachys and Sasa species	----------
Eight new spesies of Ascomycetes	1870-1880	----------	--------
Ascomycetes followed by Basidiomycetes	1880-1920	----------	----------
104 new spesies of Ascomycetes	1951-1970	----------	[30, 40]
Basidiomycetes	---------		[41-44]
Coelomycetes	1971 and so on	----------	[41] and [45-48]
Hyphomycetes	----------		[30, 32 ,40] and [49-56]

Significance of Bambusicolous:

Bambusicolous fungi are generalists, but the host plays an important role in determining species composition, and the structure of fungal community, especially the relative frequencies of individual species and submerged bamboo culms support a significantly higher fungal diversity than their terrestrial counterparts. Similar results were revealed and reported from the woody samples by in which the submerged wood supports a higher fungal diversity than the terrestrial wood. Bambusicolous fungi considered to show Host -Tissue specificity infers that particular fungus is restricted to particular host tissues or organs[57,58] which was not all obligate parasitic fungi always have strict host specificity. Mostly Bambusicolous fungi are pathogenic. *Ceratosphaeria phyllostachydis* S. Zhang causes destruction of Phyllostachys pubescens Mazel[7] that made heavy lost of bamboo forest in China as well as Stereo stratum corticoids (Berk. & Broome) Man that is used as wide distribution in China and makes bamboo forest a considerable loss. A list of diseases on bamboo was provided by Xu[14].

Some Bambusicolous fungi have medicinal treatment. Engleromyces goetzii Henn., Hypocrella bambusae (Berk. & Broome) Sacc. and Shiraia bambusicola Henn., Polyporusmylittae Cooke et Mass., Ganodermalucidum (Curtis: Fr.) P. Kars., and G. lipsiense (Batch) G. F. Atk. have been used as

traditional Chinese medicines to treat various human diseases and of economic importance. Dictyophora indusiata (Vent.) Desv., which is often associated with bamboo, is well known for its medical and edible value[59].

A common rust named Stereo stratum corticoids (Berk. & Broome) Magn. was reported from on many bamboo species[7]. A list of diseases on bamboo is provided by[11]. Although less noteworthy, the saprobes that degrade bamboo are also economically important as they degrade bamboo structures, such as houses and utensils.

Taxonomic distribution:

Ascomycetes have greater affinity towards bamboo that was distributed amongst 228 genera in 70 families. The Hypocreaceae has mostgenera known from bamboo, followed by the Xylariaceae, Lasiosphaeriaceae, and Clavicipitaceae. In terms of the number of species, the Xylariaceae (63 species), Hypocreaceae[63] and Phyllachoraceae[35] are the best-represented families. The genus with the most species is Phyllachora[22], followed by Nectria and Hypoxylon. Basidiomycetes represent only ca. 13% of the total number of fungi described or recorded from bamboo, with 70 genera distributed in 42 families. Phyllachora species were studied known to be common on the Poaceae[60]. Only the Tricholomataceae has more than 10-recorded generadue to lesser importance of basidiomycetes in the decay of bamboo, and the absence of ectomycorrhizal associations among monocotyledons. Of the mitosporic fungi, more than 230 hyphomycetes belonging in 45 genera have been described or recorded from bamboo. The most represented genera are Acrodictys, Coniosporium, Periconia, Podosporium and Sporidesmium[41,50,51,61]. Coelomycetes are the least represented group of fungi on bamboo. Ascochyta and Pseudolachnella are well represented[45,48]. Several new species of freshwater fungi were described from bamboo e.g. Fluminicola coronate[62]. The rare occurrence of coelomycetes on bamboo may be due to their low diversity on bamboo, or they may have been understudied.

Ecological Aspects:

The majority of pathogenic bamboo fungi have been reported from leaves with few records from culms and one of the most common diseases of the caused by bamboo is Leaf spot diseases caused by several species of Phyllachora[10,11,60,63]. We split fungi into two main groups; the saprobes, which can obtain their food by decomposing dead organic matter and the pathogens and endophytes, which live on/in living plant tissues. In general the obligate Fungal Diversity, pathogens included species of Puccinia, Stereostratum and Uredo. Some of these fungi have very narrow host ranges and may occur on only a singlevariety[64]. Fusarium, Phyllachora and Sclerotium species recorded as facultative parasites on bamboo. Thirty-seven taxa were also been isolated as endophytes of bamboo[33]. Most of the taxa identified were typical of endophytes of other monocotyledonous hosts.

CONCLUSION

Bamboo fungi are very important for ecological point of view. These are cosmopolitan and pathogenic and caused various infection allergies as well as produce myotoxins. The field of mycology i.e., little in touch has increases the chances for further studies.

Outcome for Future studies:

Studies should be carried out on bamboo hosts, particularly in less well-studied regions (e.g. Indonesia, Papua New Guinea). Isolation and identification of fungi from bamboos is still an essential step towards understanding ecosystem communities as many species of the fungi are unknown at present. The difference between terrestrial and fresh water submerged bamboo fungi should also be in great interest for further study which will provide phylogenetic evidence.

An assay should be conduct by utilising Endophytes as biological control agent against pathogen. To promote sporulation of endophytic mycelia sterilia in culture protocols are needed in order to perform assay[65], or molecular techniques need to be developed further[66-67] to identify and establish the role of non-speculating endophytes.

It is desirable to study fungal succession on various substrata, including bamboo, and in different environments in order to establish the dynamics of fungal succession on these hosts as there is no information about the degradation of fresh bamboo to old bamboo culms.

Bambusicolous fungi are hosts specific so that they can establish a relation to the any substrate which can provide them proper nourishment.

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