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DETERIORATION OF PURANA QILA (OLD FORT) DELHI BY FUNGAL BIODIVERSITY

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ABSTRACT

Purana Qila (Old Fort) of Delhi is situated on the bank of Yamuna constructed by the Mughal emperor Humayun and Afghan Sher shah Suri (The Lion King) is an oldest fort of India. Since then the present structures are under serious threat of microbial deterioration and exposer to various human pathogenic fungi on large number of visitors coming every day. Thus a total of thirty fungal species belonging to twenty one genera were recorded being responsible of monumental biodeterioration as well to human pathogen.

KEYWORDS: Deterioration, Fungal diversity. Old Fort, Delhi.

INTRODUCTION

Fungi play a vital role in deterioration of our cultural heritage, museum objects as well as for stone monuments in different climatic condition. There are various factors damaging cultural heritage but fungi play the most important role and this is because of lack of knowledge and training for restorers and curators. There are various physical, chemical and biological factors damaging monuments. Biological factors are crucial in the decay of monuments such as bacteria, algae, mosses, fungi, insects, birds and human beings. Fungi play an important role in bio deterioration of stone monuments due to complex metabolic activities on stone surface among all biological agents. The biological growth of microorganisms can cause permanent loss of stone monuments due to staining, cracking, and displacement of building material. Fungal metabolites can cause solubilization of cat ions and produce patinas of different mineralogical composition. The bio deterioration of stone monuments starts by up taking of calcium. Later on, this leads to eroded surface and exposes it to water and frost attack. Fungi form black biofilms on the surface of monuments. Therefore, the study of fungal diversity on monuments is always helpful for the proper preservation of monuments.


MATERIALS AND METHODS

Deteriorated stone samples were collected from March 2015 to Dec 2016 of fungal degraded portion from different localities of Purana Qila namely Qila-i-Kuhna mosque, Khairul-manzil, Humayun Gate, as well, West, North and South Gates, by Swabbing, Scrapping and Cellophane tape, sampling methods. Thereafter, Dilution (10^3/plate) with sampling material prepared and incubated at 25^0C ± 3^0C for 4 -6 days. The colonies were counted for CFU (Colony Forming Unit) under Sterio - Binocular on generic level and further by Research Compound Microscope for different species identification. Thereafter, total number of colonies counted from each plate and their percentage diversity calculated for each fungal species against each year of 2015 -2016 and being tabulated as follows:

Table 1: Mycodiversity (2015-2016) recorded from different locations of Old Fort.

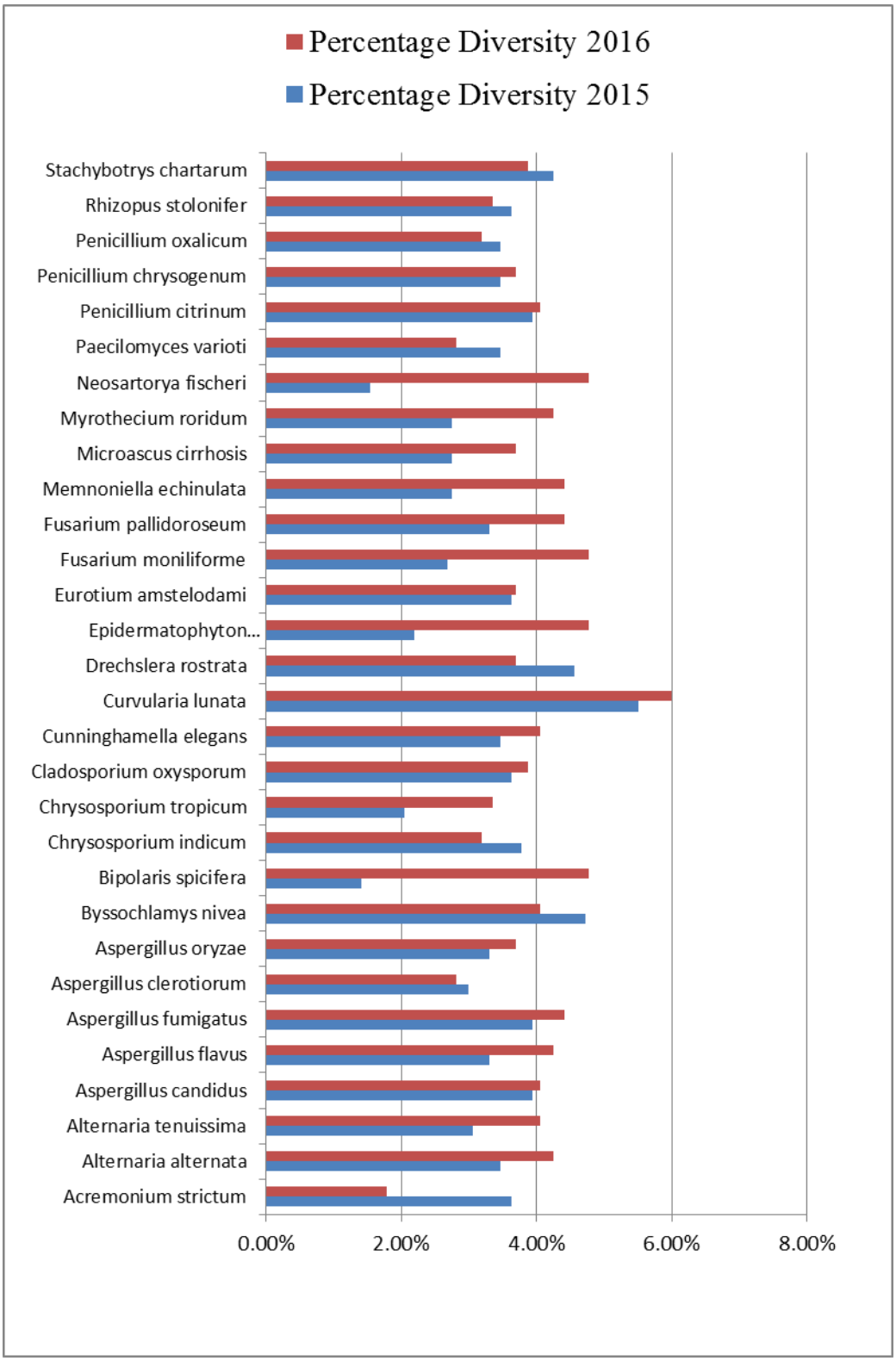
SN	Fungi Isolated/year	% Diversity 2015	% Diversity 2016	Average % Diversity
01	*Acremonium strictum*	3.62%	1.78%	2.70%
02	*Alternaria alternata*	3.46%	4.24%	3.85%
03	*Alternaria tenuissima*	3.06%	4.06%	3.56%
04	*Aspergillus candidus*	3.93%	4.06%	4.00%
05	*Aspergillus flavus*	3.30%	4.24%	3.77%
06	*Aspergillus fumigatus*	3.93%	4.41%	4.17%
07	*Aspergillus sclerotiorum*	2.99%	2.82%	2.91%
08	*Aspergillus oryzae*	3.30%	3.70%	3.50%
09	*Byssochlamys nivea*	4.72%	4.06%	4.39%
10	*Bipolaris spicifera*	1.41%	4.77%	3.09%
11	*Chrysosporium indicum*	3.77%	3.18%	3.48%
12	*Chrysosporium tropicum*	2.04%	3.35%	2.70%
13	*Cladosporium oxysporum*	3.62%	3.88%	3.75%
14	*Cunninghamella elegans*	3.46%	4.06%	3.76%

15	*Curvularia lunata*	5.51%	6.00%	5.76%
16	*Drechslera rostrata*	4.56%	3.70%	4.13%
17	*Epidermatophyton floccosum*	2.20%	4.77%	3.49%
18	*Eurotium amstelodami*	3.62%	3.70%	3.66%
19	*Fusarium moniliforme*	2.69%	4.77%	3.73%
20	*Fusarium pallidoroseum*	3.30%	4.41%	3.86%
21	*Memnoniella echinulata*	2.75%	4.41%	3.58%
22	*Microascus cirrhosis*	2.75%	3.70%	3.23%
23	*Myrothecium roridum*	2.75%	4.24%	3.50%
24	*Neosartorya fischeri*	1.54%	4.77%	3.16%
25	*Paecilomyces varioti*	3.46%	2.82%	3.14%
26	*Penicillium citrinum*	3.93%	4.06%	4.00%
27	*Penicillium chrysogenum*	3.46%	3.70%	3.58%
28	*Penicillium oxalicum*	3.46%	3.18%	3.32%
29	*Rhizopus stolonifer*	3.62%	3.35%	3.49%
30	*Stachybotrys chartarum*	4.25%	3.88%	4.07%

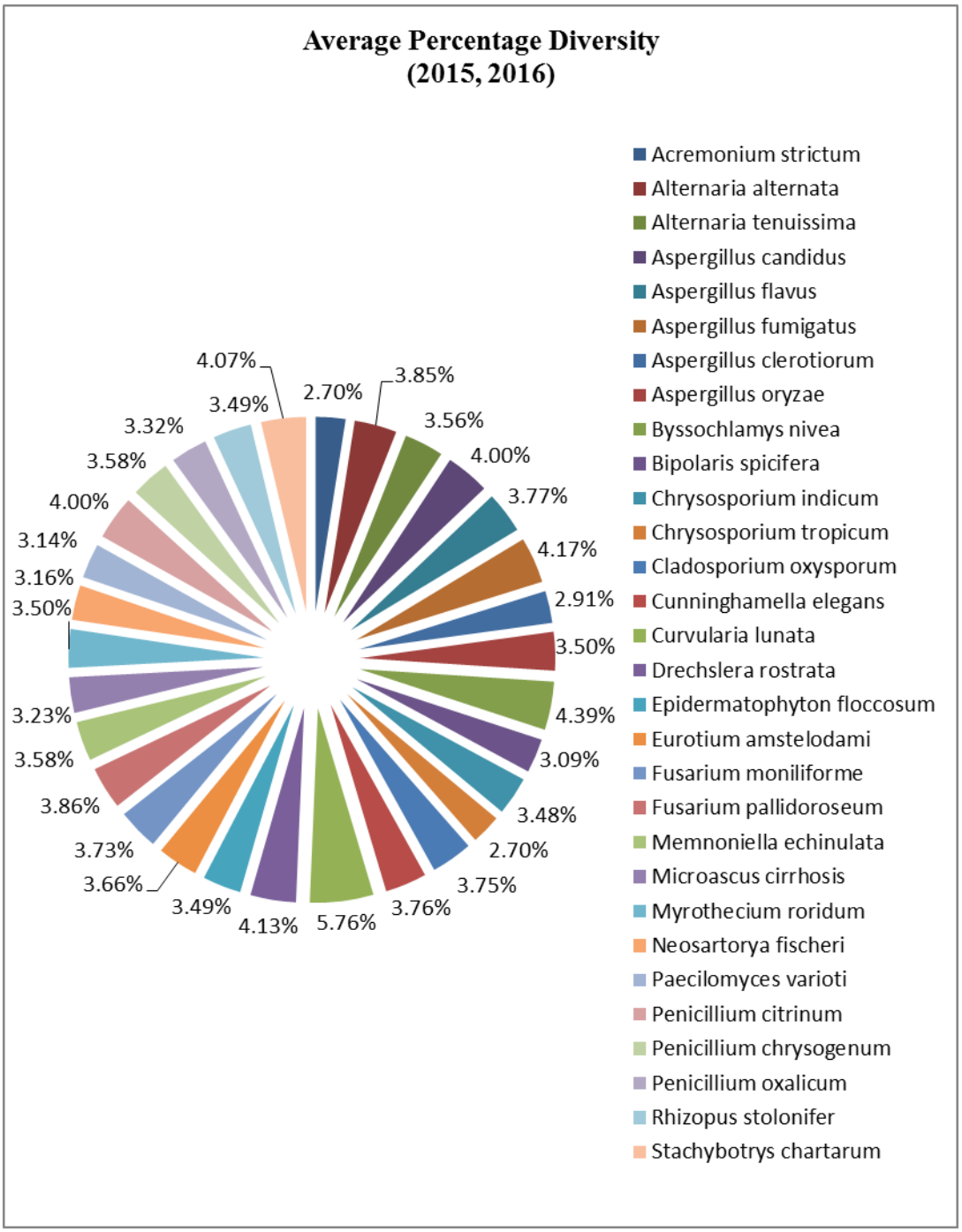
RESULT AND DISCUSSION

During investigation total 30 fungal species belonging to 21 genera were isolated from Purana Qila (Old Fort), during March 2015 to Dec 2016. The maximum fungal diversity (4.0% to 5.76%) were recorded against *Aspergillus candidus, Aspergillus fumigatus, Byssochlamys nivea, Curvularia lunata, Drechslera rostrata, Penicillium citrinum, Stachybotrys chartarum*. While, optimum diversity (3.09% to 3.86%) *were Alternaria alternata, Alternaria tenuissima, Aspergillus flavus, Aspergillus oryzae, Bipolaris spicifera, Chrysosporium indicum, Cladosporium oxysporum, Cunninghamella elegans, Epidermatophyton floccosum, Eurotium amstelodami, Fusarium moniliforme, Fusarium pallidoroseum, Memnoniella echinulata, Microascus cirrhosis, Myrothecium roridum, Neosartorya fischeri, Paecilomyces varioti, Penicillium chrysogenum, Penicillium oxalicum, Rhizopus stolonifer* and minimum diversity (2.00% to 2.99%) were *Acremonium strictum, Aspergillus sclerotiorum* and *Chrysosporium tropicum.*

Percentage Diversity of Purana Qila (2015, 2016)



Average Percentage Diversity of Purana Qila (2015, 2016)



The Fungal diversity recorded during the present investigation is in conformity of the findings mad**e**[10,8,9,7, 5,3] The identified micro fungi cause discoloration as well as mechanical exfoliation of stone material that was analyzed through hyphae penetration and production of different[10,5] pigments (*Cladosporium* sp. and *Alternaria* sp.) and organic acids some species of genus *Aspergillus* sp., *Alternaria* sp. and *Penicillium* sp reported that a large number of fungi have great biochemical decay potential. Recently, it has been apparent that the ability of

fungi to interact with minerals, metals, metalloids and organic compounds through biomechanical and biochemical processes, makes them ideally suited as biological weathering agents of rock and building stone. Biological and mycological investigations are a very important part of good conservation and cannot be ignored in the modern conservation concept, which includes close collaboration between art and Science. This collaboration is the comparative study of the role of microbial colonization on the degradation of historic monuments[2,4] as well as to human pathogen.[7]

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