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RESEARCH ARTICLE

INDEXING OF FUNGAL FLORA ON DETERIORATING SANDSTONE MONUMENTS WITH SPECIAL REFERENCE TO KALA DERA-II TEMPLE AT MANWAL (JAMMU and KASMIR STATE, INDIA)

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ABSTRACT

Fungi are complex communities of microorganisms that have deteriorating effects on historic sandstone monuments. This myco-ecological study was specifically made to examine the diversity of fungi associated with deteriorated monuments sites. In the present investigation, 10 samples were collected from various portions of deteriorating sites of Kala Dera-II temple at Manwal. Six fungal species were isolated from deteriorated monument sites are reported in this paper. Among these, Fusarium (Schlechtendahl) fungal species has been found having maximum frequency.

Key Words: Degradation, Deterioration, Sandstone Monument, Micro-Flora, Biofilm

INTRODUCTION

Kala Dera- II temple is assignable to circa 10^{th}-11^{th} century AD (Superintending Archaeologist, 2012) and is located in Udhampur District of Jammu and Kashmir state of India. It is Saptratha on plan externally. It is built on a raised platform approached by a flight of steps on the east. The roof of the mandapa was supported on four fluted columns surmounted capitals. On the west side there is a makaramukha pranala through which the water used to flow into a small rectangular cistern is carved out of a single block.

Besides the principal entrance, facing the central aisles, it has two smaller entrances at the rear. The figure on the jambs of the door and the porch are now defaced. The sikhara is intact on the western side and externally the temple is adorned with plain projecting niches and offsets bearing carving. On the south-east corner, basements of the other two shrines are positioned. The sandstone surfaces of various sites of the temple monument are continuously affected by physical, chemical and biological agents.

Among biological agents, microorganisms are responsible for the destruction of cultural heritage (Bock and Sand 1993; Ciferri 1999). They cause damages on the stone surfaces by formation of biofilms, chemical reactions with the substrate, physical penetration in to the substrate as well as pigment production. Numerous studies have dealt with establishing the role of biological agents in the stone deterioration (Pochon and Jaton 1968; May et al., 1993).

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During recent decades there has been a growing concern about deterioration of historic building by chemical and physical factors as well as microbial population growth on the surface of stone. The microbial growth on the surface of stone play an important role in this deterioration process (Suihko, 2007). There are numerous monuments in Udhampur District of Jammu and Kashmir state. One of such monument, the kala Dera – II temple [Fig. 1]. Stone surfaces of this temple are continuously exposed to physical, chemical and biological degradation.

Often, physical, chemical, and biological agents act in co-association, ranging from synergistic to antagonistic, leading to the deterioration, ultimately affecting the stone durability. The aim of this work is to study the micro fungi community on monuments by using myco-ecological parameters and microscope observations in order to evaluate the importance value index and damage caused by fungal species.

Experimental Section

Sampling and Isolation of fungi

A total of 10 Samples were collected from various locations of Kala Dera-II temple of Manwal of Udhampur district of J and K State and brought to the laboratory under aseptic conditions.

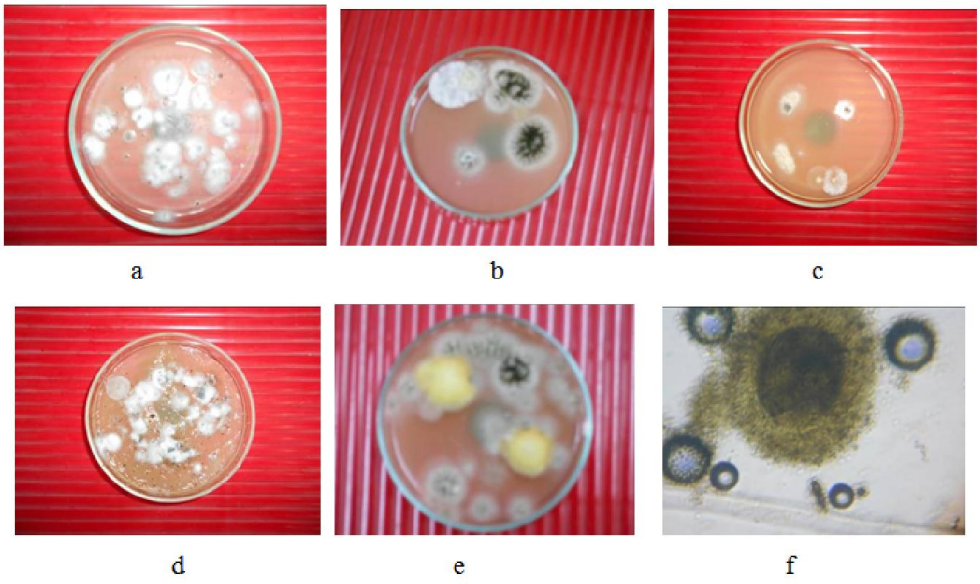
The isolation of micro- organisms was done by culturing the samples and by direct incubation of samples in moist chamber (Fig. 2). The purified fungal cultures were identified by using mycological techniques and were compared with the available authentic literature, reviews and mycological manuals (Alexopoulus 1978; Barnett and Hunter 1987; Ellis 1976: Gilman 1995).

a b

Fig -1: Kala Dera – II temple of Manwal a- Front view b- lateral view

Observation Table

Isolated fungi	Culture plates										F %	D	Ab
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10			
Aspergillus sydowi (Thom and Church.)	2	-	1	-	1	1	-	1	-	-	50	0.60	1.20
Aspergillus flavus (Link.)	-	-	4	3	-	-	-	-	2	-	30	0.90	3.00
Aspergillus niger (Tieghem.)	-	5	2	-	8	-	6	-	-	4	50	2.50	5.00
Fusarium oxysporium (Schlechtendahl.)	1	1	-	1	-	1	-	1	1	1	70	0.70	1.00
Penicillium sanguifluum (Sopp.)	1	2	-	3	-	-	-	-	2	-	40	0.80	2.00
Bipolaris sorokinianum (Schoemaker.)	-	3	2	-	-	3	-	5	-	1	50	1.40	2.80



a b c

d e f

Fig 2. a, b. c. d. e and f: View of growth of fungal species on culture media in Petri plate

Calculations

Various myco-ecological parameters have been calculated using the following formulae:

$$\text{Frequency (F \%)} = \frac{\text{Number of plates in which specific organism occurred}}{\text{Total number of plates examined}} \times 100$$

$$\text{Density (D)} = \frac{\text{Total number of colonies of specific organism}}{\text{Total number of plates examined}}$$

$$\text{Abundance (Ab)} = \frac{\text{Total number of colonies of specific organism}}{\text{Number of plates in which specific organism occurred}}$$

RESULTS AND DISCUSSION

During screening for search of mycoflora, total six species of fungal organisms were isolated from Kala Dera-II temple. Composite result indicate that in all the ten (10) plates were mainly dominated *Fusarium oxysporum* due to their high percentage frequency followed by *Aspergillus sydowi, Aspergillus niger and Bipolaris sorokinianum* in the study areas. Some of the fungal species are confined to particular area i.e. *Aspergillus sp., Rhizopus nodosus* and *Chaetomium globossum*. These confinements of fungal species depend on environmental conditions of the area, which varies from geographical area to area (Salvadori, 2000). In the present study *Fusarium* species is found to have most commonly populated on almost all the sites of this historic monuments.

The composition of fungal organism has variation which depends upon biochemical nature of host, degree of competition between the fungal organisms and the prevailing environmental conditions. The frequency and relative frequency are directly or indirectly correlated with meteorological data and climatic conditions (Chandel, 1990). In each fungal community all the species are not equally important. There are relatively only few of these, which determine the nature of the community (Simpson, 1949). These few species exert a major controlling influence on the community and also play important role in deterioration of various substrates.

It has also been shown in the laboratory that fungal species such as *Aspergillus niger* were able to solubilize powdered stone and chelate various minerals in a rich glucose medium because they produce organic acids such as gluconic, citric, and oxalic acids (Lapidi and Schipa, 1973). The toxic metabolites produced by various species of fungal organisms function as chelating agents that can leach metallic cations, such as Iron, Magnesium etc from the stone surface. Laboratory experiments have demonstrated that basic rocks are more susceptible to fungal attack than acidic rocks. In the present study *Aspergillus* are the most common species found in the sites. *Aspergillus niger* released certain metal ions from the rock samples (Boyle and Voight,1973).

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REFERENCES

Alexopoulos, C.J. 1978. Introductory mycology (2nd Ed.). Wiley Estern Ltd. New Delhi, Banglore, Bombay

Barnett, H.C. and Barry, B. 1987. Hunter Illustrated genera of important fungi. Macmillan Publishing Company. New York and Collier. Macmillon Publishers, London

Bock, E. and Sand, W. 1993. The microbiology of masonry biodeterioration. *J. Appl. Bacteriol*. 74: 503-514

Boyle, J.R. and Voight, G.K. 1973. Biological weathering of silicate minerals. Implications for tree nutrition and soil genesis. *Plant and Soil*. 38: 191-201

Chandel, D.S. 1949. Studies of Phylloplane interaction of fungi from Soybean and Pigeon pea. Ph.D. Thesis. Pt. Ravishankar University, Raipur

Ciferri, O. 1999. Microbial degradation of paintings. Appl. Environ. *Microbiol,* 65: 879-885

Ellis, B.M. 1976. More Dematiaceous Hyphomycetes. CMI, Kew, England

Gilman, C. and Joseph, 1995. A Manual of Soil Fungi. Print well publication, Jaipur , India

Lapidi, A.A. and Schipa, G. 1973. Some aspects of the growth of chemotrophic and heterotrophic bacteria from decayed stone. In: Proceedings of the 5th International Congress on deterioration and conservation of stone. (Ed) G.Felix Lausanre, Switzerland. 633-640

May, E., Lewis, F.J., Pereira, S., Tayler, S., Seaward, M.R.D. and Allsopp, D. 1993. Microbial deterioration of building stone: A review. Biodeterioration Abstracts. **7**: 109-123

Pochon, J. and Jaton, C. 1968. Biological factors in the alteration of stone. In: A. H. Wolters, CC Elphick, Eds., Biodeterioration of Materials. Elsevier, Amsterdam. 258-268

Salvadori, O. 2000. Characterization of endolithic communities of stone monuments and natural outcrops. Kluwer Academic Publishers, New York. 89-101

Simpson, E.H. 1949. Measurement of diversity. Nature. 163 – 688

Suihko, L.M., Alakomi, L.H., Gorbushina, A.A., Fortune, I. and Marquardt, S.M. 2007. Characterization of aerobic bacterial and fungal microbiota on surfaces of historic Scottish monuments. *Syst. Appl. Microbiol.,* 30: 494-508

Superintending Archaeologist, 2012. Centrally protected monuments of Jammu region. Archaeological Survey of India, Srinagar Circle (J and K)

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