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SACRED GROVES: TREASURE HOUSE OF LEAF SPOTTING AND SOIL FUNGI

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ABSTRACT: Taxonomical and ecological studies on leaf spotting fungi and soil fungi from selected sacred groves of Central Kerala were done. Twenty species of fungi were identified from these forest patches. Eleven species were leaf-spotting fungi of which nine belonged to class Duteromycotina and two species to class Ascomycotina. Nine species were soil fungi. Of this, three belonged to class Duteromycotina, five belonged to Basidiomycotina and one to Ascomycotina. All indicates their role in bio-geochemical cycle of these regions. *Cercosporidium chaetomium* was a new species record to Kerala. *Cladosporium herbarum* was found on a new host *Sandalum album* which was a new host record to Kerala.

KEYWORDS: Sacred groves, leaf spotting fungi, soil fungi, central Kerala.

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1.INTRODUCTION

Sacred groves are isolated patches of forest delimited and protected by human societies in the midst of agricultural landscape in an undisturbed condition [1]. They act as a functional link between forest management system and social life of a region [2]. They provide an invaluable gene pool, conserve biodiversity, helps in soil and water conservation and thereby contribute to ecosystem services [3]. The total area of sacred groves in India as a whole reported so far may cover over 42000 ha [4]. According to some findings [5] about 500 ha of forest area is under sacred grove, which contributes to 0.05% of the total forest area of Kerala [6]. The size of sacred groves in Kerala varies as small as

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one cent to 20 or more hectares. About 79% of them are small i.e. below 0.02 ha. in extent [7]. Cultural homogenization and real estate demands leads to the disappearance of sacred groves at an increased rate [8]. Sacred groves provide unique habitat where abundant species of fungi can be sustained and thereby play an important role in conservation of fungi [9]. The kingdom of fungi contains 1.5 million fungal species, of which 74,000 species are named [10]. One third of fungal diversity of the globe exists in India. The number of fungi reported in India exceeds 27,000 species, the largest biotic community after insects [11]. Tropical climate of Kerala is very congenial for luxuriant growth of fungi. Silent Valley forests in Kerala have a rich and most diverse species composition [12]. The team recorded 255 spp. and 152 genera of Hyphomycetes from this region alone. Several studies for fungal diversity collection [13] [14] [15] recorded over thousand fungal taxa from Kerala, the southern peninsular sate of India during the last few decades. In spite of the enormous work put- in on the fungal systematics, the mycoflora of India is still only partly explored especially of the Southern India. The present study aims to investigate the fungal biodiversity of some selected sacred groves of Central Kerala. No much work has been carried out on fungal flora of these regions. Different taxonomic groups of fungi are found in some special habitats where they form a specialized group adapted to a particular set of habitat conditions. Fungi collected and studied for the present work were based on the habitat. The possibility of indexing the leaf spotting fungi and soil fungi belonging to different taxonomical groups are investigated in the present study.

2. MATERIALS AND METHODS

Study area includes ten sacred groves of Central Kerala. They are Iringole kavu, Chovvazcha kavu, Koozhipilly kavu, Panichayam kavu, Kuzhupilly kavu), Chakarakattu kavu, Palakkattu kavu, Chorian kavu, Vallikattu kavu and Aalpara kavu (Table.1) (Figure.1). Periodic collection of fungi were made from the above ten sacred groves during summer season from February to April. For field collections, vasculum, lens, knife, scissors, tag, etc. were used. Most of the host plants were identified in the field itself. The specimens were brought to the laboratory and infected regions were critically examined using dissection microscope for symptamatology. Tease mounts and scratch mounts were made for microscopic observations. Hand sections were also made. Mounting was done on slide using5%KOH and lactophenol, as general mounting media. Cotton blue was used for staining. Sections were observed under a research microscope (Olympus trinocular) for studying detailed morphological characters. Measurements of all microscopic structures were taken using micrometer. Drawings were made using a camera lucida (Prism type) attached to the microscope. Macro fungal fruit bodies were wrapped in paper bags and brought to laboratory. Spore prints were taken on micro slides / paper by keeping the fresh fruit body in humid condition. Measurement and detailed observation of fruit body were made in the laboratory and the materials dried in a hot air oven at 70 c. Representative portions of the dried specimens were used for microscopic studies. The

rest of the fruit body were treated with mercuric chloride against mites and moulds and stored with mothballs in paper as voucher specimens.

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Figure 1: Sacred groves (a) Chakarakattu kavu (b) Panichayam kavu (c) Kuzhupilly kavu (d) Palakkattu kavu

For soil fungi, soil samples were collected and brought to laboratory in sterilized polythene bags. 5-15 mg of soil was added aseptically into sterile Petri dish. Plates were incubated at room temperature. To isolate the fungal species, soil was inoculated to culture medium. All the materials collected during this period of investigation were deposited at the Mycological herbarium, Dept. of Botany, Union Christian College, Aluva.

Table 1. Location and area (in hectares) of ten selected sacred grooves

Sl. No.	Sacred groves	Site (SG)	Area (ha.)	Coordinates	
1	Iringole kavu	SG1	16	10.10912	76.50041
2	Chovvazcha kavu	SG2	0.12	10.14063	76.45865
3	Koozhipilly kavu	SG3	0.10	10.11952	76.43488
4	Panichayam kavu	SG4	0.08	10.1071	76.56339
5	Kuzhupilly kavu	SG5	0.61	10.11696	76.47166
6	Chakkarakattu kavu	SG6	0.10	10.12786	76.47761
7	Palakattu kavu	SG7	0.20	10.11391	76.46252
8	Chorian kavu	SG8	0.12	10.10581	76.58877
9	Vallikattu kavu	SG9	0.20	10.13225	76.47555
10	Aalpara kavu	SG10	0.40	10.1867	76.49038

3. RESULTS AND DISCUSSION

Fungi collected and studied from the present study were classified based on habitat into leaf spotting fungi and soil fungi. After critical microscopic observation the materials were assigned to the respective species.

Leaf spotting fungi: Leaves form suitable substrate for many fungi. The leaf surface is a most inhospitable niche in both physical and chemical terms for fungi. Eleven species of leaf spotting fungi were collected and studied from these sacred groves (Table. 2). Among them nine belonged to class Duteromycotina, of which four were of order Moniliales and two of Melanoconiales. Two species of leaf spotting fungi belonged to class Ascomycotina of which one included in order Meliolales and one in order Phyllachorales. Leaf spotting fungi of Kerala was studied and reported by several workers [16] [17] [18] [19], which includes most of the species identified but data are scanty on sacred grove fungal studies. A detailed survey revealed a rich flora of plant pathogenic fungi harboring the plants in different ecosystems of Western Ghats [20]. Study on endophytic fungi on tropical plants and found that reducing the size and increasing the number of leaf fragments will increase the number of fungal species isolated [21].

Table 2. Distribution of leaf spotting fungi in study area

Sr.No.	Fungus	Host	Site
1	*Alternaria alternata* (Fr.) Keissler	*Ocimum sanctum* L *Bambusa bambos* (L.) Voss.	SG4 SG8
2	*Cercospora tremae* (Stev & Soth) Chupp.	*Ocimum sanctum* L	SG4
3	*Cercosporidium chaetomium* (Cooke) Deighton	*Euphorbia pulcherima*Willd.	SG2
4	*Cladosporium herbarum* (Pers.)Link.	*Santalum album* L.	SG1
5	*Colletotrichum gloeosporioides* Penz. &Sacc.	T*erminalia paniculata*Roth.	SG1
6	*Corynespora cassiicola* (Berk & Curt.) Wei	*Lantana camera* L.	SG7
7	*Curvularia lunata* (Wakk.)Boed.	*Gossypium hirsutum* L.	SG8
8	*Meliola ixorae* Yates var. *macrospora* Hosag.	*Ixora nigricans* R.Brown .Ex W& A.	SG6
9	*Pestalotia calophylli* P.Henn.	*Calophyllum inophyllum* L.	SG1
10	*Phyllachora repens* (Corda.)Sacc.	*Ficus religiosa* L	SG9
11	*Zygosporium oscheoides*Mont.	*Ficus religiosa* L.	SG5

Dark setae are present in *Colletotrichum gloeosporioides* and *Meliola ixorae*. Conidial scars are prominent in Cercosporidium chaetomium and Cercospora tremae. Conidia were found in chains in *Cladosporium herbarum* and *Alternaria alternate*. Conidia were septate in *Cercosporidium chaetomium* (up to 3), *Corynespora cassiicol*a (numerous), *Curvularia lunata* (3*), Alternaria alternata* (transverse and longitudinal), *Cercospora tremae* (10-15) and *Pestalotia calophylli* (4). In Zygosporium oscheoides conidiophores bear a vesicle which was terminating in a knob. Two species of *Cercosporidium, C.helleri* and *C.henningsii* was reported from Ernakulam district of Kerala. [22][23]. *Cercosporidium chaetomium* was a new species to Kerala. *Cladosporium herbarum* was reported on seeds and seedlings of *Albizzia odoratissima* and on seeds of *Pterocarpus marsupium* from Thrissur district of Kerala [24]. But it was not reported earlier on the host*, Santalum album* from Kerala.

Soil Fungi: Soil fungi are also important as decomposers. They digest hard-to-digest organic materials. Fungal hyphae physically bind soil particles together, creating stable aggregates that help to increase soil water holding capacity. A study for soil fungi with 158 samples from various areas

of four districts of Kerala and screened for prevalence keratinophyllic fungi and related dermatophytes-a total of 8 genera with 15 species were isolated [25]. In present study nine species of fungi were isolated from soil (Table.3) (Figure.2). Three species were microscopic and six macroscopic. Microscopic fungi – *Graphium putredinis, Humicola grisea* and *Nigrospora sphaerica* belonged to class Duteromycotina and order Moniliales. *Graphium putredinis* was reported from Wayanad (Kerala) on dead stems of a palm [26]. Only this species of *Graphium* has been reported from Kerala [15]. Among macroscopic fungi, *Volveriella speciosa,Termitomyces microcarpus* and *Marasmius floriceps* belongs to Agaricales of Basidiomycotina. *T. microcarpus* was reported on soil from Mulamkuzhi (Ernakulam), Peechi (Thrissur), Malabar and Malappuram [27][28][13][20]. *Dictyophora sp.* and *Geastrum triplex* belongs to order Phallales and Lycoperdales respectively of Basidiomycotina. *Xylaria rhombica* belongs to Ascomycotina and order Xylariales. Conidiophores are synnematous in *Graphium putredinis*. *Volvariella speciosa* was provided with a persistent volva. *Dictyophora sp*. has got a well developed inducium which hangs down and form a network.

Table 3. Distribution of soil fungi in study area

Sl.No.	Fungus	Site
1	Dictyophora sp.Dev.	SG8
2	*Geastrum triplex* Junghuhn.	SG1
3	*Graphium putredinis* (Corda.)Hughes.	SG1
4	*Humicola grisea* Traaen	SG5
5	*Marasmius floriceps* Berk.& Curt.	SG1, SG3
6	*Nigrospora sphaerica* (Sacc.)Mason.	SG1
7	*Termitomyces microcarpus* (Berk &Br.) Heim.	SG10, SG3, SG2
8	*Volvariella speciosa* (Fr. ex Fr.)Singer.	SG3, SG8
9	*Xylaria rhizomorpha* (Mont.)	SG1

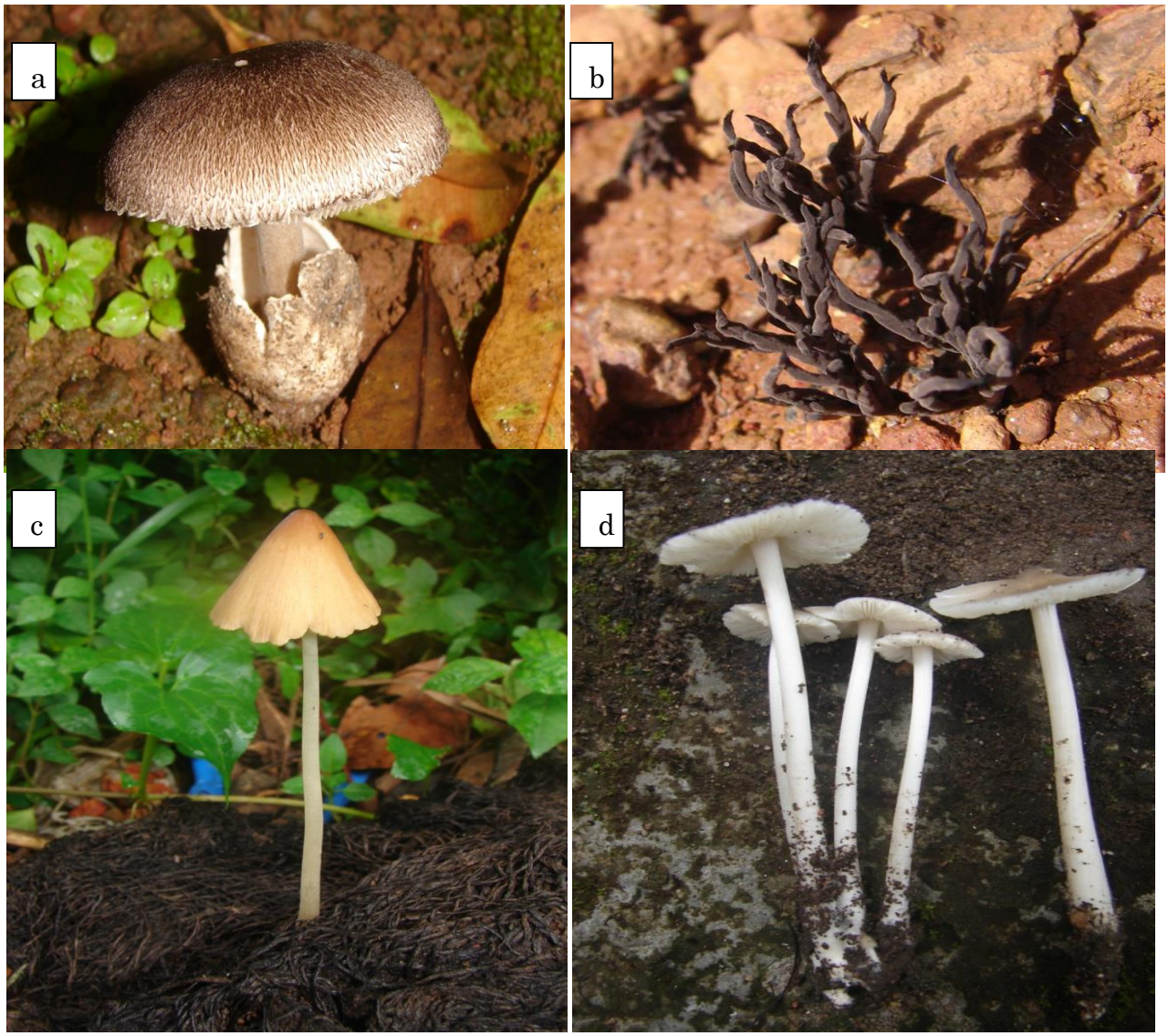

Figure 2. Fruiting bodies of (a) *Volvariella speciosa* (Fr. ex Fr.) Singer. *(b) Xylaria rhizomorpha* (Mont.) Mont. *(c) Marasmius floriceps* Berk. & Curt. *(d) Termitomyces microcarpus* (Berk &Br.) Heim.

4. CONCLUSION

Results covering- up taxonomical and ecological studies on different groups of fungi from the isolated forest patches (sacred groves) of Central Kerala, forty species of fungi studied add to the mycoflora of Kerala. Literature survey clearly indicates that the study on fungal diversity of sacred groves was a totally unexplored area and hence adds new information to science. Thus the present investigation especially with respect to taxonomy and systematic of fungi has indicated possibilities of further exploration and getting more and more interesting forms, if a concentrated and intensified approach is being made by future research workers.

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6. CONFLICT OF INTEREST

Authors have no conflict of interest.

REFERENCES

1. Hughes JD, Chandran MS. Sacred groves around the earth: an overview. Conserving the sacred for biodiversity management- New Delhi (Oxford and India Book House), 1998; 69-86.
2. Boraiah KT, Vasudeva R, Bhagwat SA, Kushalappa CG. Do informally managed sacred groves have higher richness and regeneration of medicinal plants than state-managed reserve forests? *Current Science*. 2003; 84:804–808.
3. Amirthalingam M. Sacred Groves of India – An Overview. Int. J. Curr. Res. Biosci. Plant Biol. 2016; 3(4): 64-74
4. Malhotra KC, Gokhale Y, Chatterjee S, Srivastava S. Cultural and ecological dimensions of sacred groves in India. *New Delhi and Bhopal, India: Indian National Science Academy and the Indira Gandhi Rashtriya Manav Sangrahalaya*. 2001.
5. Prasad GA, Mohanan CN. The sacred groves of Kerala and biodiversity conservation. In Proceedings of the 7th Kerala Science Congress. State Committee on Science, Technology and Environment, Thiruvananthapuram, Kerala 1995; 125-126.
6. Chandrashekara UM, Sankar S. Structure and Function of sacred groves: Case studies in Kerala, In: Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (eds.) Conserving the Sacred for Biodiversity Management, Oxford and IBH. Publishing Co., New Delhi, 1998; 323-36.
7. Chand BS. Conservation and Management of Sasred Groves in India. 1998; 337- 347.
8. Bhagyanathan M, Kasthurba AK, Thampi SG, Dhayanithy D. Sacred Groves in Peri-Urban Areas: An Opportunity for Resilient Urban Ecosystems. International Journal of Earth Sciences and Engineering. 2017; 10(1): 75-82.
9. Brown N, Bhagwat S, Watkinson S. Macrofungal diversity in fragmented and disturbed forests of the Western Ghats of India. Journal of Applied Ecology, 2006; 43(1): 11-17.
10. Hawksworth DL, Kiek PM, Sutton BC, Pegler DN. Dictionary of the Fungi, CAB Intl. 1995; 616.
11. Sarbhoy AK, Agarwal DK, Varshney JL. Fungi of India 1982-1992, CBS Publishers & Distributers, N.D, 1996; 350.
12. Subramanian CV. The progress and status of mycology in India. Proc.Indian acad. Sci., Plant Sciences, 1986; 96(5): 379-392.

13. Hosagoudar VB, Abraham TK, Pushpangadan P. Fungi of Kerala. TBGRI, Palode, Tvm, Kerala, India. 1996; 151.
14. Sankaran KV, Florence EJ, Balasundaran M, Nawshad KI. 1997. Fungal Diversity. 1997; 140-148.
15. Florence EJ. Biodiversity Documentation for Kerala, Part 2: Microorganisms (Fungi). KFRI Handbook. 2004; (17)1: 293.
16. Hosagoudar VB. The genus *Phyllachora* Nki in Fckl. In Kerala State. J. Econ, Taxon.Bot. 1989; 13(1): 121-124.
17. Hosagoudar VB. Meliolaceous fungi on rare medicinal plants in S. India. Zoos Point J. 2003; 18(7): 1147-1154.
18. Chowdappa P, Mohanan C, Ramanujan B. Occurrence of *Phytophthoracapsicii* on cacao in Kerala. Indian Phytopath. 1993; 46(1): 92-93.
19. Dhanalekshmi C, Leelavathy KM. Leaf spot of Cardamom caused by *Phaeotrichoconis crotalariae*. Plant. Dis. Rptr. 1976; 60 (2): 188.
20. Mohanan C. Mycorrhizaein forest plantation: Association, Diversity and Exploitation in planting improvement. KFRI Research Report. 2003; 252.
21. Gamboa MA, Laureano S, Bayman P. Measuring div. of endophytic fungi in leaf fragments. Does size matter? Mycopathologia. 2002; 156: 41-45.
22. Rangaswami G, Seshadri VS, Channamma KL. Fungi of South India. Univ. Agri. Sci. Banglore. 1970; 193.
23. Varghese KIM, Rao VG. Fungi Imperfecti from Kerala (S.India)-II. J. Annamalai Univ. Part B Sciences. 1987; 33: 137-147.
24. Ali MIM, Sharma JK. Impactof seed microflora on seed germination and seedling vigour of some important indigenous tree species of Kerala. Proc. IUFRO Symposium on Impact of Disease and Insect Pests in tropical forests, KFRI, Peechi, Thrissur, Kerala. 1996; 33-51.
25. Desmukh SK. The maintenance and preservation of keratinophyllic fungi and relatedDermatophytes, Mycoses. 2003; 46:203-207.
26. Rao VG, Varghese KIM. Fungi- Imperfecti from Kerala, South India-I, Biovigyanam. 1979; 5:77-80.
27. Leelavathy KM, Sr. Little Flower, Suja CP. The genus Termitomyces in India. 1983; 403-407.
28. Sankaran KV, Florence EJ. Macrofungal flora and checklist of plant diseases of Malayattoor forest (Kerala), 1995; 147-168.