J.Mycopathol.Res. 63(2) : 337-346, 2025, ISSN : 0971-3719 (Print), 2583-6315 (Online)
10.57023/JMycR.63.2.2025.337

Diversity of soil mycoflora in the Paddy field of Upper Kuttanad, Alappuzha District, Kerala State

SHIGI JOSEPH* AND NEETA N. NAIR
Post Graduate and Research Department of Botany, Mar Thoma College, Thiruvalla-689103, Kerala

Received : 14.12.2024 Accepted : 06.05.2025 Published : 30.06.2025

In the current study focusing on the diversity of soil mycoflora in the Paddy field of the Upper Kuttanad soil region of Alappuzha district, Kerala, a total of 53 fungal species were identified across two crop seasons (Summer Crop Season - Puncha and Monsoon Crop Season - Virippu) in the year 2016-2018. These species belonged to two classes Zygomycetes and Ascomycetes. The monsoon crop season showed the highest diversity with 32 species, whereas the summer Crop season recorded the lowest with 30 species.

Keywords : Ascomycetes, monsoon crop, paddy field, soil mycoflora, summer crop, Zygomycetes

INTRODUCTION

Soil is a vibrant habitat for a complex colony of fungi that operates as an active biological environment. Within the soil, fungi exist, develop, reproduce, and ultimately die or break down, generating valuable organic matter that can be reused as plant nutrients. This naturally produced humus complex acts as a fertilizer that gets integrated into the soil and greatly influences its composition (Rane and Gandhe, 2006). Fungi thrive in the soil due to their remarkable flexibility and adaptability. Paddy fields are among the most fertile ecosystems on the planet, distinguished by their specific biogeochemical cycles, as well as diverse microflora and fauna (Vijayan and Ray, 2015).Although a lot of research has been done on soil fungi, not much is known about the fungi that are specifically prevalent in rice fields. To ascertain the advantages and disadvantages of these soil microorganisms, an in-depth study of the fungal populations associated with organic farming practices may be necessary, particularly in this understudied field.

*Correspondence : shigijh13@gmail.com

MATERIALS AND METHODS

Study area

The upper Kuttanad is situated alongside waterways and makes up the lower portions of the southern and eastern margins of Kuttanad. Usually, this location is located 1-2 meters below mean sea level.

Collection of soil samples

Samples were systematically taken from paddy fields during the period of two seasons using standard soil sampling techniques. For sampling, four to five plots of approximately ten m^2 were selected from each field. In each survey, soil samples were taken between 0 -15 cm below the surface and combined to form a composite soil sample. A total of three composite samples were taken from the region. Until the materials were processed for fungal isolation, they were kept at 4^0 C (Sankaran and Balasundaran, 2000).

Isolation of fungi from the soil samples

The soil dilution method on Potato Dextrose Agar was used as an isolation technique (Waksman, 1922). Fungi were isolated using dilutions of 10^-

^{3},10^{-4}, and 10^{-5}. For each dilution, 1 ml of a soil suspension was added to the sterilized Petri dishes containing Potato dextrose Agar media in triplicate. Before the media was poured into Petri plates, ambistryn was added to avoid the growth of bacteria. The Petri plates were then incubated at 26 ±1^{0}C for seven days. The colonies formed from the 10^{-3} dilutions were counted and recorded.

Identification of Fungal cultures

Identification of the fungal species was based on morphological characteristics of the colony (developing degree of cultures, the color of colonies and change in color, the reverse color of the plate and change in its color, pigmentation, exudates produced texture, etc) and microscopic features (hyphae, conidia, conidiophores, an arrangement of spores and resting bodies). The identification of fungi was done with the help of direct mount from pure culture and its slide culture. In the direct mount method, a small bit of pure culture was transferred to the center of a clean glass slide containing a drop of lactophenol cotton blue. The mycelium was spread evenly using a needle and a coverslip was placed on it. Colony characters like growth, pigmentation, texture, and color, and microscopic characters like hyphae conidia, conidiophores an arrangement of spores, and resting bodies formed the basis for identification. Microscopic studies and analyses were carried out with the help of the Olympus Digital Binocular Compound microscope (CX21iLED). Microphotographs were captured by a Magcam DC10 CMOS camera of 10 megapixels with the help of Mag Vision image analyzer software. The identification and description of fungi there made with the help of authentic manuals, various books, review published, research papers, monographs (Gilman, 1957; Raper & Fennell, 1965; Raper &Thom, 1949) and online data basis (mycobank; http://www.mycobank.org; Shodhganga; http://shodhganga.inflibnet.ac.in). All the cultures were identified followed by authentication in the National Centre for Fungal Taxonomy (NCFT), and National Fungal Culture Collection of India (NCFCCI) Pune.

Quantitative Analysis

The percentage contribution of the soil mycoflora were calculated with the help of the following formula (Subha *et al.,* 2013)

Percentage contribution

The percentage contribution of each isolate was calculated

$$\% \text{ contribution} = \frac{\text{Total Number of Colonies of an individual species}}{\text{Total Number of Colonies of all species}} \times 100$$

Statistical analysis of soil mycoflora

The diversity index (Shannon Wiener Index, Simpson index) and Species evenness of all fungal species were also statistically analyzed by PAST-4.03 software package.

RESULTS AND DISCUSSION

In the current study, 53 fungal species were obtained over two growing seasons (Summer crop season - Puncha and Monsoon crop season - Virippu) from 2016 to 2018. The most fungal species were observed during the monsoon crop season (32 spp), while the lowest was observed in the summer crop season (30 spp). Characteristics of some of the isolated fungi are given below:

1. *Choanephora cucurbitarum* (Berk. & Ravenel) Thaxt. 1903. *Rhodora*. 5:99 (NCFT 9843.20)

Colonies white to grayish white, sporulating in concentric zones; sporangiophores arising from surface hyphae, unbranched, gradually enlarging above, often bent or circinate below the sporangia, hyaline, becoming darkened above, with a maximum diameter of 30 µm: sporangia spherical to slightly flattened in the larger ones, at first white, later black, measuring up to 156 µm containing from few to many sporangiospores, columella pyriform to globose, with a small collar, up to 120 × 108 µm.

2. *Cunninghamella elegans* Lendner, A.1907. *Bulletin de l Herbier Boissier*. 2 ser., 7:249-251 (NCFT 9835.20)

Colonies growing rapidly, up to 4 cm high, on aging becoming compacted, at first white, later with dark spots of conidia, mycelium mostly aseptate, hyaline, or with granular content, sometimes with oil droplets; hyphae up to 20 µm in diameter.

Conidiophores erect, with verticillate or solitary branches; vesicles subglobose to pyriform, verrucose or smooth, the terminal ones up to 40 µm in diam., the lateral ones 10-30 µm; conidia globose. 7-11 µm, or ovoid to ellipsoidal, 6-10 × 9-13 µm, smooth, verruculose, or shortly echinulate, hyaline, or with granular contents, brownish in mass; zygospores globose, slightly compressed between the suspensors, brownish, tuberculate, 253-55 µm in diam.

3. Mucor circinelloides Tiegh, P.1875. *Ann Sci Nat., Bot,* ser. 6, 1:5-175. (NCFT 9644.20)

Colonies expanding, floccose, light greyish-brown. Sporangiophores hyaline, up to 6 mm high, 17 µm wide, repeatedly branched, forming two layers of different heights: longer branches erect, shorter ones often recurved. Sporangia 20-80 µm diam, membrane diffluent in larger but persistent in smaller sporangia; columellae spherical to ellipsoidal, about 50 µm wide. Sporangiospores smooth-walled, ellipsoidal, 4.5-7.0 × 3.5-5.0 µm. Chlamydospores are absent or scant. Zygospores. Zygospores are spherical to slightly compressed, up to 100 µm wide, with stellate spines, reddish-brown to dark brown. Suspensors are equal to slightly unequal. Heterothallic.

4. Rhizopus nigricans Ehrenberg, CG.1820. *Nova Acta Phys.Med. Acad. Caes. Leop.Carol. Nat. Cur* 10(1): 159-222. (NCFT 9786.20)

Sporangiophores are usually straight, slightly rough or smooth-walled, pale brown or dark brown; 500-3500 µm in length, and 13-29 µm in diameter. Sporangia globose or subglobose; black at maturity; 50-360 µm in diameter. Columellae were globose, subglobose, or oval; the wall was usually smooth, pale brown, 50-160 µm in diameter. Sporangiospores globose, oval, polygonal, elliptical, or irregular in shape; striated; 4-12 µm in length or diameter. Chlamydospores are absent on stolons. Zygospores not observed. Rhizoids are abundant and root-shaped. Stolons are slightly rough, almost colorless or brown; 13-20 µm in diameter.

5*. Syncephalastrum racemosum* Cohn, 1886. Kryptogamen-Flora von Schlesien 3.1 (2): 129-256 (NCFT 9637.19)

Colonies are expanding., with abundant aerial mycelium, greyish. Sporangiophores arising from rhizoids, irregularly branched, 10 - 25 µm wide, each branch bearing a terminal vesicle up to 80 µm diam, which produces mero sporangia over the entire surface. Merosporangia grey, cylindrical, up to 33 × 4 µm, containing 3-18 spores in a single row. Merospores are smooth-walled, pale brown, spherical to ovoidal, 3-7 µm diam. Zygospores. Zygospores between equal suspensors, black, spherical, 50-90 µm diam, with conical projections. Heterothallic.

6. Acremonium exiguum Gams,W.1971. *Trans. Br. mycol. Soc.* **64**(3): 1 - 262. (NCFT 9803.20)**.**

After 10 days at 28°C, the colonies had a diameter of 11 mm and were either white or pale peach with a slightly dusty appearance. The vegetative hyphae were very small and thinly tunicated. Sporulation was mostly phalacrogenous. The phialides were usually simple, slightly notched, and 15-30 µm long, narrowing from 1.0-1.2 µm to 0.5 µm. The conidia were connected in mucilaginous heads, ellipsoid in shape, and measured 2.0-2.7 (-3.5) x 1.0-1.5 µm. Chlamydospores were also present.

7. Aspergillus niger Tiegh, 1867. *Ann.Sci.Nat. Bot.* 8: 240 -244(NCFT 9389.18)**.**

On PDA, colonies consist of a compact white or yellow basal felt covered by a dense layer of dark-brown to black conidial heads. Conidial heads were large (up to 3 mm by 15 to 20 ìm in diameter), globose, dark brown, becoming radiate, and tending to split into several loose columns with age. Conidiophore stipes were smooth-walled, hyaline, or turning dark towards the vesicle. Conidial heads were biseriate with the phialide borne on brown, often septate metulae. Conidia are globose to subglobose (3.5-5 ìm in diameter), dark brown to black and rough-walled.

8. Penicillium chrysogenum Thom, C.1979. *Bull, Bur. Anim. ind. US dep. Agric.*118: (58).328-381(NCFT 9640.19)**.**

Colonies radially sulcate and dense with a floccose overgrowth; mycelium at the margins is white. At the centers, it is white to yellowish white. Conidiation is light to moderate. Conidia *en masse*

blue or bluegreen; exudate produced, pale to bright yellow or yellow-brown; reverse red-brown or pale. Conidiophores are borne from surface or subsurface hyphae, stipes 200 -300 × 3 - 4 µm, smooth, typically verticillate with 1-2 rami, either terminal and appressed or sometimes subterminal and divergent; rami 15-20 × 3-4µm; metulae in verticils of 3-5, short and appressed,8-12 × 2.2 -2.5 µm; phialides 4-7 per verticil, ampulliform,7-8 × 2.2-2.5µm, with short abruptly narrowing collula; conidia ellipsoidal, 2.54 × 2.2-3.5µm, smooth, borne in long irregular columns.

9. Talaromyces flavus Stolk& Samson, 1972. *Studies in Mycology*.2:165(NCFT 9760.20)**.**

Colonies sulphurious honey yellow, margin dull olivaceous reverse buff. Hyphae branched, septate. Gymnothecium/Ascomaata is olivaceous, globose to subglobose, texura angularis, 82.31-176.96 × 74.98–123.00 µm. Penicilli mono to verticillate. Conidiophores produced from superficial hyphae, light olivaceous,52.95-82.26 × 3.5-3.8µm. Phialides short, ampulliform, 2-many in numbers per verticelli, 6.63 × 3.96 µm. Ascus numerous, globose, light olivaceous,8 ascospored, yellowish brown, up to 11.33 × 9.5 µm. Ascospores globose to subglobose, light olivaceous, 5.396.65 × 3.85-5.0 µm. Anamorphic conidia found in chain, 4.12-5.98 × 3.85 -4.45 µm.

10. Trichoderma hamatum (Bonord.) Bainier, 1906. *Bulletin de la Société Mycologique de France*. 22: 131 (NCFT 9763.20)**.**

Colonies on PDA at 25 C with dense mycelium, conidia forming in concentric rings, no diffusing pigment or distinctive odor produced. Conidiophores in pustules comprise a sterile elongation with the fertile part arising near the base. Phialides arise from short lateral branches at the base of the elongation. Phialides tapering slightly from base to tip or somewhat enlarged in the middle, 6.7-13.2 µm long, 2.5-3.5 µm at the widest point, 2.0-3.0 µm at the base, arising from a cell 2.5-3.0 µm wide. Conidia ellipsoidal, 4.0-5.0 × 3.0-3.5 µm, smooth.

11. Fusarium moniliforme Sheldon, 1904. Rep. *Neb. agric. Exp. Stn*.17:23-32. (NCFT 9638.19)**.** Colonies grew fast, pale, lilac, vinaceous, cream, or violet in color. Reverse light pink. Conidiophores bearing micro and macroconidia. Macro conidia were rare, straight, 3-5 septate, 31-58 × 2.5 - 3.5 µm in size, thinwalled, apical cell elongated, curved, and basal cell pedicellate. Micro conidia were powdery in appearance, formed in the chain, narrowing at the apex, 20 – 30 × 2-3 µm in size.

12. Alternaria alternata (Fr.) Keissl, 1912. *Beih. bot. Zbl.*, Abt. 29:395440 (NCFT 9390.18)**.** Colonies growing rapidly on PDA, reaching 6 cm diam., blackish brown; conidiophores short, straight, 3-septate, branched or unbranched, sometimes geniculate, up to 50 µm long, 3- 6 µm wide; conidia forming often in long branched chains, muriform with 3-8 transverse septa, walls rough in lower part with longitudinal or oblique septa, obclavate, ovoid, ellipsoidal, often with a short or cylindrical beak, smooth, medium golden brown, pale, 20-63× 9-13 µm; beak pale and upto 1/3 the length of conidium, 2-5 µm wide.
Microphotopgraphs of these fungi have also been presentd in Fig.1.

Seasonal variation of soil mycoflora in Upper Kuttanad

The variations of soil mycoflora in Upper Kuttanad in both summer and monsoon were studied are results obtained are depicted in Table 1.

Summer crop season

During the observation period, 232 colonies were isolated in the first year, 206 in the second year, and 208 in the third year. A total of 646 fungal colonies were obtained during summer, belonging to 30 species under 15 genera. These species belonged to two groups Zygomycetes and Ascomycetes. Ascomycetes was observed to be the dominant group with 27 species and the zygomycetes contributed 3 species. In the summer season, the highest number of colonies was observed by *Aspergillus niger* (87) followed by *Aspergillus fumigatus*(66), *Penicillium chrysogenum* (52), *Aspergillus flavus* (45), *Syncephalastrum racemosum*(44), *Alternaria alternata*(41), *Mucor circinelloides*(38), *Curvularia lunata*(35), *Aspergillus terreus*(30), *Choanephora*

Table 1: Percentage contribution and number of colonies (10^{-3} dilution) of fungal isolates in Upper Kuttanad (2 crop seasons)

		Crop Season 1 (SUMMER)		Crop Season 2 (MONSOON)	
Sl.No.	Fungal isolates	Total fungal colonies	% contribution	Total fungal colonies	% contribution
Class: Zygomycetes					
1	*Choanephora cucurbitarum*	24	3.71	0	0
2	*Cunninghamella elegans*	0	0	65	6.41
3	*Mucor circinelloides*	38	5.88	0	0
4	*Mucor hiemalis*	0	0	37	3.64
5	*Rhizopus nigricans*	0	0	44	4.33
6	*Rhizopus stolonifer*	0	0	91	8.97
7	*Syncephelastrum racemosum*	44	6.81	0	0
	Class: Ascomycetes				
8	*Acremonium byssoides*	0	0	12	1.18
9	*Acremonium exciguum*	0	0	23	2.26
10	*Acremonium kiliense*	7	1.08	0	0
11	*Acremonium sclerotigenum*	4	0.61	14	1.38
12	*Acremonium strictum*	4	0.61	32	3.15
13	*Alternaria alternata*	41	6.34	67	6.60
14	*Aspergillus candidus*	0	0	20	1.97
15	*Aspergillus clavatus*	0	0	22	2.16
16	*Aspergillus flavus*	45	6.96	0	0
17	*Aspergillus fumigatus*	66	10.2	57	5.62
18	*Aspergillus nidulans*	0	0	28	2.76
19	*Aspergillus niger*	87	13.4	77	7.59

20	*Aspergillus ochraceous*	15	2.32	0	0
21	*Aspergillus parasiticus*	23	3.56	0	0
22	*Aspergillus penicillioides*	8	1.23	0	0
23	*Aspergillus terreus*	30	4.64	86	8.48
24	*Aspergillus versicolor*	0	0	58	5.71
25	*Chaetomium globosum*	0	0	27	2.66
26	*Colletotrichum capsici*	6	0.92	0	0
27	*Cladosporium cladosporoides*	5	0.77	0	0
28	*Cladosporium oxysporum*	0	0	9	0.88
29	*Curvularia lunata*	35	5.41	22	2.16
30	*Curvularia pallescence*	2	0.30	0	0
31.	*Eupenicillium ochrosalmoneum*	0	0	6	0.59
32	*Fusarium moniliforme*	0	0	30	2.95
33	*Fusarium oxysporum*	0	0	25	2.46
34	*Fusarium sachaari*	11	1.70	0	0
35	*Graphium penicillioides*	0	0	9	0.88
36	*Monilia fructigena*	0	0	10	0.98
37	*Neosartorya fumigata*	0	0	3	0.29
38	*Penicillium chrysogenum*	52	8.04	29	2.85
39	*Penicillium citrinum*	19	2.94	0	0
40	*Penicillium corylophilum*	11	1.70	0	0
41	*Penicillium digitatum*	0	0	43	4.24
42	*Penicillum expansum*	23	3.56	0	0
43	*Penicillium olabrum*	5	0.77	0	0

44	*Penicillium lanosum*	0	0	16	1.57
45	*Phoma glomerata*	9	1.39	9	0.88
46	*Phoma herbarum*	3	0.46	0	0
47	*Paecilomyces variotii*	6	0.92	0	0
48	*Talaromyces helicus var. maj.*	8	1.23	0	0
49	*Talaromyces flavus*	7	1.08	0	0
50	*Trichoderma hamatum*	0	0	8	0.78
51	*Trichoderma harzianum*	8	1.23	0	0
52	*Trichoderma virense*	0	0	26	2.56
53	*Verticillium terrestre*	0	0	9	0.88

Table 2: Species Diversity index of soil mycoflora in Upper Kuttanad

Diversity indices	Summer crop season	Monsoon crop season
Dominance D	0.06432	0.0493
Simpson_1-D	0.9357	0.9507
Shannon_H	2.995	3.195
Evenness_e^H/S	0.6661	0.7628
Berger Parker	0.1347	0.08974

cucurbitarum (24), *Aspergillus parasiticus*(23), *Penicillium expansum*(23), *Penicillium citrinum* (19), *Aspergillus ochraceous* (15), *Fusarium sacchari*(11), *Penicillium corylophilum* (11), *Phoma glomerata*(9), *Talaromyces helicus var. major* (8), *Trichoderma herzianum* (8), *Aspergillus penicillioides* (8), *Talaromyces flavus*(7), *Acremonium kiliense* (7), *Colletotrichum capsci*(6), *Paciliomyces variotii*(6), *Cladosporium cladosporoides* (5), *Penicillium glabrum*(5), *Acremonium sclerotigenum*(4), *Acremonium strictum*(4), *Phoma herbarum*(3). The lowest number of colonies was observed by *Curvularia pallescence*(2)

Monsoon crop season

Variation in soil mycoflora was observed during the investigation period in Upper Kuttanad. During this time, 354 colonies were isolated in the first year, 312 in the second year, and 348 in the third year. A total of 1,014 fungal colonies belonging to 32 species under 18 genera were isolated during the monsoon crop season. These species belonged to two classes Zygomycetes and Ascomycetes. Ascomycetes were observed to be the dominant group with 28 species and 4 species contributing to the Zygomycetes. In monsoon crop season, the highest number of fungal colonies was observed by *Rhizopus*

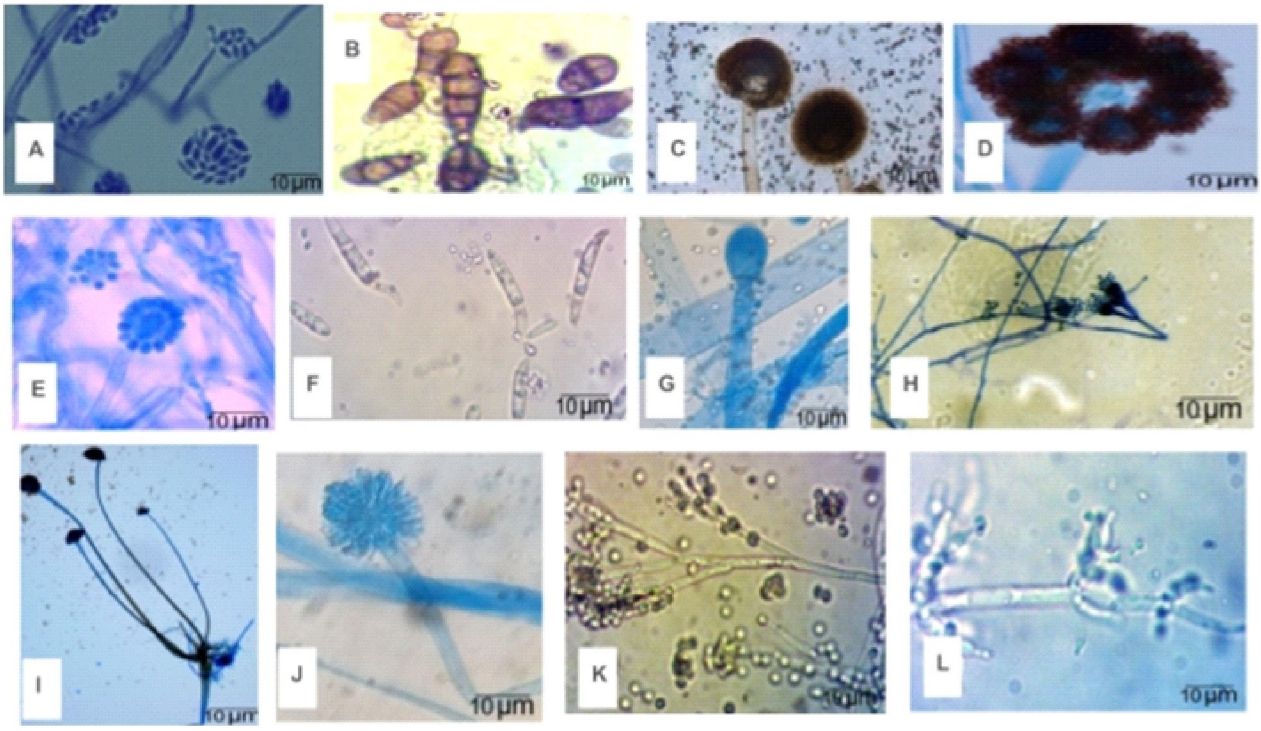

Fig. 1: (A-L): Microphotographs of some of the isolated fungi. A- *Acremonium exiguum*; B- *Alternaria alternata;* C-*Aspergillus niger*; D- *Chonephora cucurbitarum*; E- *Cunninghamella elegans*; F-*Fusarium moniliforme*; G- *Mucor circinelloides*; H-*Penicillium chrysogenum*; I- *Rhizopus nigricans*; J- *Syncephalastrum racemosum*; K- *Talaromyces flavus*; L- *Trichoderma hamatum*

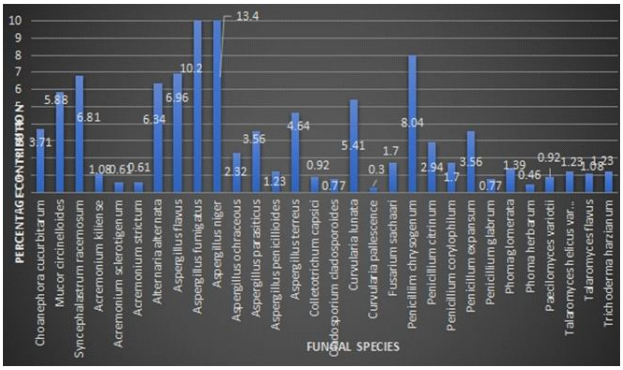

Fig.2: Percentage contribution of soil mycoflora in Upperkuttanad (Summer crop season)

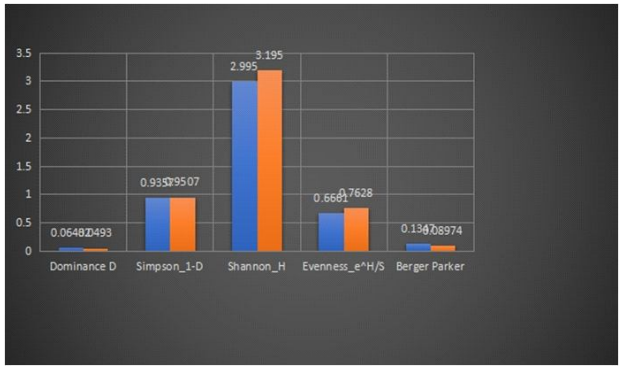

Fig.4: Species Diversity index of soil mycoflora

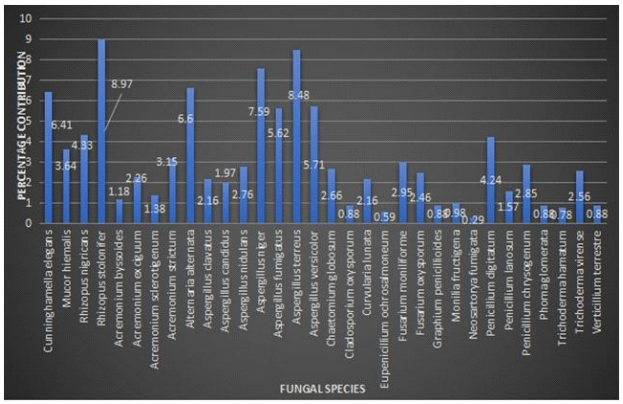

Fig.3: Percentage contribution of soil mycoflora in Upperkuttanad (Monsoon crop season)

stolonifer (91) followed by *Aspergillus terreus* (86), *Aspergillus niger* (77), *Alternaria alternata*(67), *Cunninghamella elegans*(65), *Aspergillus versicolor*(58), *Aspergillus fumigatus*(57), *Rhizopus nigricans*(44), *Penicillium digitatum*(43), *Mucor heimalis*(37), *Acremonium strictum* (32), *Fusarium moniliforme*(30), *Penicillium chrysogenum* (29), *Aspergillus nidulans* (28), *Chaetomium globosum*(27), *Trichoderma virense* (26), *Fusarium oxysporum* (25), *Acremonium exiguum*(23), *Curvularia lunata* (22), *Aspergillus clavatus*(22), *Aspergillus candidus* (20), *Penicillium lanosum* (16), *Acremonium sclerotigenum*(14), *Acremonium*

byssoides(12), *Monilia fructigena* (10), *Cladosporium oxysporum*(9), *Graphium penicillioides* (9), *Phoma glomerata* (9), *Verticillium Terrestre* (9), *Trichoderma hamatum* (8), *Eupenicillium ochrosalmoneum* (6). The lowest number of fungal colonies was observed by *Neosartorya fumigata* (3)

Percentage contribution of soil mycoflora in Upper Kuttanad

The contribution of different soil mycoflora in Upper Kuttanad in both summer and monsoon were studied are results obtained have also been depicted in Table 1.

Summer crop season

The maximum percentage contribution (Fig.2) was shown by *Aspergillus niger* (13.4%) followed by *Aspergillus fumigatus* (10.2%), *Penicillium chrysogenum*(8.04%), *Aspergillus flavus* (6.96%), *Syncephalastrum racemosum*(6.81%), *Alternaria alternata*(6.34%), *Mucor circinelloides*(5.88%), *Curvularia lunata*(5.41%), *Aspergillus terreus*(4.64%), *Choanephora cucurbitarum* (3.71%), *Aspergillus parasiticus*(3.56%), *Penicillium expansum*(3.56%), *Penicillium citrinum* (2.94%), *Aspergillus ochraceous* (2.32%), *Fusarium sacchari*(1.70%), *Penicillium corylophilum* (1.70%), *Phoma glomerata*(1.39%), *Talaromyces helicus var maj* (1.23%), *Trichoderma herzianum* (1.23%), *Aspergillus penicillioides* (1.23%), *Talaromyces flavus*(1.08%), *Acremonium kiliense* (1.08%), *Colletotrichum capsci*(0.92%), *Paciliomyces variotii*(0.92%), *Cladosporium cladosporoides* (0.77%), *Penicillium glabrum*(0.77%), *Acremonium sclerotigenum*(0.61%), *Acremonium strictum*(0.61%), *Phoma herbarum*(0.46%). The minimum percentage contribution is shown by *Curvularia pallescence* (0.30%).

Monsoon crop season

The maximum percentage contribution was shown by *Rhizopus stolonifer* 8.97% followed by *Aspergillus terreus* with 8.48% *Aspergillus niger* (7.59%), *Alternaria alternata*(6.41%), *Cunninghamella elegans*(5.00%), *Aspergillus versicolor*(5.71%), *Aspergillus fumigatus*(5.62%), *Rhizopus nigricans*(4.33%), *Penicillium digitatum*(4.24%), *Mucor heimalis*(3.64%), *Acremonium strictum*(3.15%), *Fusarium moniliforme*(2.95%), *Penicillium chrysogenum* (2.85%), *Aspergillus nidulans* (2.76%), *Chaetomium globosum*(2.66%), *Trichoderma virense* (2.56%), *Fusarium oxysporum* (2.46%), *Acremonium exiguum*(2.26%), *Curvularia lunata* (2.16%), *Aspergillus clavatus*(2.16%), *Aspergillus candidus* (1.97%), *Penicillium lanosum* (1.57%), *Acremonium sclerotigenum* (1.38%), *Acremonium byssoides* (1.18%), *Monilia fructigena* (0.98%), *Cladosporium oxysporum* (0.88%), *Graphium penicillioides* (0.88%), *Phoma glomerata* (0.88%), *Verticillium Terrestre* (0.88%), *Trichoderma hamatum* (0.78%), *Eupenicillium ochrosalmoneum* (0.59%). The minimum percentage contribution is shown by *Neosartorya fumigata* (0.29%) (Fig. 4).

In this study, the class Ascomycetes represents the highest number of fungal species (46), while the lowest number of species is found in the class Zygomycetes (7). Ascomycetes are better equipped to withstand environmental stresses and can utilize more resources, contributing to their dominance in soils (Egidi *et al.* 2019). In the present study, *Aspergillus* (11) and *Penicillium* (7) showed the maximum number of species. Similar results were obtained from the previous workers. Species diversity index of soil mycoflora of Upper Kuttanad has been revealed in Table 2 and Fig.4. Madhanraj *et al.* (2010) reported that 24 fungal species, representing 12 genera, were recorded. *Aspergillus* was the most prevalent, followed by *Penicillium.* Out of 22 species screened, the *Aspergillus* and *Penicillium* were represented as dominant ones by Senthilkumar *et al.* (2009). Similarly, Ratnakumar *et al.* (2015) reported that among the obtained fungal isolates, the dominant genera were *Aspergillus* and *Penicillium.* Research on fungal diversity and the contribution of soil mycoflora provide valuable insights for farmers, agronomists, researchers, and microbiologists, aiding future efforts in conserving soil ecosystems, maintaining microbial diversity, and promoting sustainable agriculture.

ACKNOWLEDGMENT

Thanks are due to Dr. P.N. Chowdhry, Principal Mycologist at the National Centre for Fungal

Taxonomy (NCFT), and the National Fungal Culture Collection of India (NCFCCI) in Pune for the fungal culture identification and authentication, as well as the Department of Botany at Mar Thoma College in Thiruvalla for providing the lab and other facilities.

DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

REFERENCES

Egidi, E., Delgado, B., Manuel, P., Jonathan, M.W., Juntao, E., David, J.B., Richard D.M., Fernando T.&Singh, B. K. 2019. A few Ascomycota taxa dominate soil fungal communities worldwide. *Nature Communications*, 10(1), 1–9. https://doi.org/10.1038/s41467-019-10373-z

Gilman, J. 1957. *A Manual of soil fungi* (second). Iowa State Colege Press, Ames.

Madhanraj, P., Manorajan, S., Nadimuthu, N.&Panneerselvam, A. 2010. An investigation of the mycoflora in the dune of soils of the coast,.India. *Adv. Appl. Sci. Res*, 1(3), 160–167.

Rane, G., Gandhe, R. V. 2006. Seasonal distribution of soil fungi from forest soils of Jalgaon District, Maharashtra. *Zoos' Print Journal*, 21(9), 2407–2409. https://doi.org/10.11609/jott.zpj.1542.2407-9

Raper, K.B., Fennell, D. L. 1965. *The Genus Aspergillus*. Baltimore: Williams and Company.

Raper, K.B., Thom, C. 1949. *A manual of the Penicillia.* Williams and Wilkins Co., Baltimore.

Ratnakumar, P.K., Hemanth, G.Niharika, P.,Samuel, K. 2015. Isolation and identification of soil mycoflora in agricultural fields at Tekkali Mandal in Srikakulam District. *Inter. J. Adv. Pharm. Biol. Chem.* **4**: 484–490.

Sankaran, K .V., Balasundaran, M. 2000. Soil Microflora of Shola Forests of Eravikulam National Park. *KFRI Res. Report* **197**: 1–34.

Senthilkumar,G., Madharaj, P., Kanimozhli, K., Panneerselvam, A. 2009. isolation and identification of fungal flora from mangroves of muthupet,Tamilnadu. *J.Microb.World* **11**: 31–36.

Subha, K., Kanimozhi, K.,&Pannveer Selvum, A. 2013. Investigation on isolation and identification of soil mycoflora from a terrestrial region on Melathiruppalakkudi, Thiruvarur District, Tamil Nadu. *JPR: Bio Med Rx: An Inter. J.* **1**: 734–738.

Vijayan, Dhanya, Ray, J. G. 2015. Ecology and Diversity of Cyanobacteria in Kuttanadu Paddy Wetlands, Kerala, India. *Amer. J. Plant Sci.* **06**: 2924–2938. https://doi.org/10.4236/ajps.2015.618288

Waksman, S. A. 1922. A method for counting the number of fungi in the soil. *J. Bacteriol.* **7**: 339–341.