IMPACT OF SOIL PHYSICOCHEMICAL PARAMETERS ON MICRO FUNGAL POPULATION NUMBERS IN MATTAVARAFOREST OF CHIKKAMAGALURU, KARNATAKA.

Chandini K.C.

Associate professor, Department of Botany, GSC Hassan, Mysore University

Abstract : An analysis of soil physicochemical parameters and its effect on micro fungal population numbers monitored over three seasons from 2013-2015 in Mattavara forest of chikkamagaluru, karnataka. Study revealed a total of 3368 colonies with 65 genera and 161 species isolated on PDA, CZA and RBA medium supplemented with tetracycline or streptomycin by serial dilution method. Among 65 genera *Aspergillus, Absidia, Cladosporium, Chaetomium Cunninghamella, Mucor, Penicillium, Rhizopus,* and *Trichoderma* are the nine genera were found to be the dominant micro fungi predominant in all most all the soil samples fifty six genera found to be less prevalent. Total number of colonies was more in winter followed by summer and rainy season during first two years and in the third year winter followed by rainy and summer season showed deviation from the earlier reports may be due to the seasonal disparities in the study area. *Flabellospora* and *Helicomyces* are the two aquatic fungal species also isolated. The Spearman's Correlation Coefficient study for dominance and diversity indices for fungal population showed both positive and negative significant correlation with soil physicochemical parameters. Change in rate of rain fall results in marked seasonal variation in distribution of micro fungal number by altering the moisture content, temperature, humidity, pH and micro and macronutrients status of the soil.

Key words: Diversity indices, Micro fungi, Seasons, Soil, physicochemical parameters

I. INTRODUCTION

Soil is an important abiotic component which plays a major role in sustaining life being habitat for plants and animals and is 'the uppermost weathered layer of the earth's crust' made up of different components like mineral matter 40%, organic matter 10%, soil water 25%, soil air and biological system 25%. Biological system harbors a wide variety of organism known as soil community which includes soil macro and micro fauna and flora. Micro flora constitute organisms like Bacteria, Actinomycetes, microscopic algae, Protozoans and Fungi which plays a crucial role in decomposition, symbiotic interaction and bio geo chemical cycling in the terrestrial ecosystem and make the soil rich by adding nutrients. So Soil micro fungi can be considered as primary degraders in the ecosystem. Thus soil is not an inert medium but a site of great microbial activity and that the soil fungi outnumber the fungi that grow elsewhere. Among all organisms, fungi are the second largest group in the world after insects (Hawksworth, 1991 and 2001). The diversity of micro fungi mainly depending upon the environmental factors like pH, temperature, moisture content, organic matter, soil atmosphere Rain fall etc. So we aimed to study the soil physicochemical parameters and its effect on micro fungal population numbers during different season in Mattavara forest of Chikkamagaluru , Karnataka.

II. Materials and methods

2.1. Study area

Mattavara forest is rich in biodiversity situated between 12^0 54' 42" and 13 53'53" north latitude and between 75 04'46" and 76 21'50" east latitude and located eight km away from Chikkmagaluru . The forest cover is about 224.23 hectare**.** The terrain is flat. The study area is characterized by Black and red soil with sand, silt and clay particles. Basically it is an scrub jungle but during regeneration of the plot many deciduous and evergreen trees were introduce into the forest. The flora of Mattavara forest not showed much variation in the distribution pattern in the selected study sites for the analysis of fungal diversity.

2.2. Collection of soil samples and isolation of fungi

Survey was done during rainy, winter and summer season from 2013 January to 2015 December for three consecutive years and soil samples were collected randomly. During each visit in different seasons twelve samples at the rate of 36 samples per year was collected and used for isolation of micro fungal population. Altogether 108 samples were collected for fungal isolation. Samples were collected out at the depth of 15 – 30 cm after removing an inch of surface organic matter and then brought to the laboratory for the isolation of micro fungi and for physicochemical analysis. The serial dilution method followed by Waksman, 1944 and Watanabe, 2010 were used for the enumeration of soil fungi by using PDA, CZA and RBA medium supplemented with tetracycline or streptomycin to avoid bacterial contamination. To prepare serial dilution one gram of fine soil sample was suspended in 10 ml of sterile distilled water and labeled as a stock solution. One ml of the suspension from stock was used for serial dilution and dilution was made from 10^{-1} to 10^{-4} concentration in different test tubes. One ml of sample was poured on PDA medium for the growth of fungi then incubated in an inverted position for 3-7 days at room temperature 25 ± 2^0 c. On the basis of morphological characterization the store house of fungal taxa is explored by observing color, size, shape etc. as a part of taxonomical criteria. These fungal isolates were identified with the help of relevant literature (Barnet., 1972; Gilman., 1957, Nagamani *et.al.* 2006.). To identify the fast growing fungal forms the first set of observation were made from the third day of inoculation, second and third set of observation was made at the end of fifth and seventh day of inoculum for slow growing fungi.

2.3. Soil physicochemical analysis

Collected soil samples were sieved through 2 mm mesh size to remove coarse material and used for various physicochemical analysis and the methods used are Hygrometer, Soil thermometer, Volumetric methods (Gupta, 2009), Thermometer, Electric pH meter method, Conductivity meter, Walkely and Black (1934) and Colorimetric method (Datta et al., 1962), Alkaline permanganate method (Subbaiah and Asija, 1956), Olsen's method used for neutral and alkaline soil (Olsen et al., 1954), Neutral normal ammonium acetate extract of soil (Grava, 1980), Turbidimetric method, Atomic Absorption Spectrophotometry using DTPA extractant (extraction and determination), Azomethine-H Colorimetric Method discovered by Gupta in 1979 and EDTA method. The results were compared with the diversity of fungi at different seasons

2.4. Statistical analysis

Obtained data was subjected to Spearman's Correlation coefficients (*r*) between fungal population and various physico-chemical characteristics were analyzed for three different seasons. Standard formulas in Microsoft excel, SPSS version 16.00 and Diversity calculator (online tool) for forest soil samples in winter, summer and rainy season.

The value of Correlation is significant at the level *P=0.05 (Probability at 5%) was considered as correlated significantly.

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Results and Discussion

Field survey undertaken during different seasons from 2013 -15 and Isolated fungal forms were identified on the basis of morphological characters. We have isolated 3368 colonies with a total of 65 genera and 167 species (Table.1). Among 167 species 99 species were less frequent and 62 species were common in almost all soil samples. Among 65 genera *Aspergillus*, , *Absidia*, *Cladosporium*, *Chaetomium Cunninghamella*, *Mucor*, *Penicillium*, *Rhizopus*, and *Trichoderma* are the nine genera were found to be the dominant mycoflora predominant in all most all the soil samples fifty six genera found to be less prevalent. Total number of colonies was more in winter followed by summer and rainy season during first two years and in the third year total number of isolates was more in winter followed by rainy and summer season showed deviation from the earlier reports may be due to the seasonal disparities in the study area (Fig.1.).

The highest incidence of species were *Aspergillus* with 22 species, *Penicillium* (15 sp) *Chaetomium*(10 sp), *Trichoderma* (8 sp), *Absidia* and *Phoma* (6sp) *Cladosporium*(5 sp), *Mucor*, *Fusarium* and *Pythium* (4sp) *Alternaria, Rhizopus, Torula*, *Allomyces*, *Phytophthora* (3sp) and three types of non-sporulating fungi are the richest taxa recorded in the study area.

Flabellospora and Helicomyces are the two aquatic fungal species and also reported as root endophytic fungi (Sati *et al.*, 1992.) isolated from the study plot. It may be due to the occurrence of fungi rather in moist terrestrial ecosystem than in water and appear as immigrants (Park, 1972) in the soil through rain water. The moist litter content also leads to the development of aquatic fungi.

Three types of non sporulating fungi White, brown and red coloured with septate or aseptate cottony submerged mycelium were isolated only on PDA. These NSF could not be identified on the basis of morphological characters and were failing to sporulate on different culture media required characterization by molecular techniques.

PDA media is commonly used for the isolation of soil micro fungi along with CZA and RBA media showed variation in fungal incidence. Many fungal colonies developed in all the media. But fungal incidence was more on PDA than on CZA and RBA same was reported by Bhattacharyya and Jha, 2011**.** PDA is the most favored medium for the isolation and characterization of fungal species from plant tissues and soil system. (Shivanna *et al*., 2011) Some species such as *Stachybotrys, Chaetomium, Perioconia* , *Cochliobolus* and two aquatic fungal species *Flabellospora* and *Helicomyces* were isolated exclusively on PDA medium. *Syncephalatrum* and *Paeciliomyces* were recorded on CZA and same was reported by Shivanna *et al*. in 2011. *Nigrospor aoryza, Periconia, Pithomyces* and *Torula herbarum* were isolated on RBA media and also on PDA. White, brown and red coloured NSF with septate or aseptate cottony submerged mycelium were isolated only on PDA.

Among 167 species 26.08% were isolated only during winter , followed by summer with 19.25% and 17.39% in rainy season. But few species shared different seasons. 9.32% isolated in winter and summer, 5.59% in winter and rainy season, 6.83% in summer and rainy season ,15.27% in winter, summer and rainy season (Fig.2)

Soil physicochemical analysis

Physicochemical analysis of the soil showed seasonal variation (Table.2.). Soil texture analysis showed 55.6% of sand, 27.3% of clay and 17.1% of silt which helps in retention of moisture content and availability of nutrients in the soil and provides optimum condition for the growth of the fungi. Soil pH was strongly acidic in winter followed by slightly acidic in summer and slightly neutral to alkaline in Rainy. Electrical conductivity, Nitrogen, Potassium found to be lower than the critical value. Organic carbon, phosphorus, Sulphur, Boron, Zinc, Iron Manganese, copper, calcium, magnesium concentration found to be higher than the critical value.

The Spearman's Correlation Coefficient study for dominance and diversity indices for fungal population showed both positive and negative significant correlation with soil physicochemical parameters(Table.3).

Rainfall is the main key factor showed Positive significance in rainy season, negative non significance in winter and summer. Change in precipitation results in marked seasonal variation in distribution of micro fungal number by altering the moisture content, temperature, humidity, pH nutrients status of the soil. Effect of moisture on fungal number could not be established (RamaRao 1970) and in the present findings soil moisture does not showed positive significance and same was reported by Manoharachary 1977.

Study revealed that acidic pH with more number of colonies and slightly acidic and alkaline condition resulted in less number of colonies in different seasons indicates that fungal abundance slightly increases as soil pH decreases. Fungi have wider pH tolerance for optimum growth and thus are less affected by pH gradients (Rousk *et al.,* 2010). pH and soil organic carbon does notappear to be a conclusive pattern since alterations in pH and soil carbon has non-significant effects on fungal dominance (Hogberg *et al.* 2007 and Strickland and Rousk 2010). It is a key factor governing nitrogen, phosphorous and sulphur cycles (Yu*et al*., 2007; Zhang *et al*., 2001) but organic carbon showed positive non significance. Phosphorus with negative and positive trend may be due to present in lower than the critical value. No positive correlation existed between available phosphorous and fungal population (Joshi and Chauhan (1992).

In the sandy soil fungi are less sensitive to nitrogen and have little ability to retain soluble nitrogen and might be leached through the water .So Nitrogen showed positive in winter and negative significance in Rainy season. Pottassium level is too high and Sulphur level is too low to provide significant effect.

The essential micro nutrients are available in optimum range to enhance the growth of soil micro fungi. Fungal diversity of any soil depends on a large number of factors of the soil such as pH, organic content and moisture (Poornima *et al*., 2014). The population compositions in the activity of microorganism are largely regulated by soil properties, climate and vegetation (Jha *et al.*, 1992).

Table. 1. List of soil micro fungi recorded in Mattavara forest from 2013-15			
Sl.No	Name of the fungus	Sl.No	Name of the fungus
1	**Oomycetes**	46	*Cochiliobolus lunatus* R.R.Nelson & Haasis.
2	*Achlya debaryana* Humphrey.	47	*Flabellospora* sp. Descals.
3	*Achyla recurva* Cornu.	48	*Gymnecella* spPeck.
4	*Phytophthora cryptogea* Pethybr. & Laff.	49	*Khuskia oryzae* H.J. Huds.
5	*Phytophthora palmivora* Butler.	50	*Nectria asakawaensis* Ts. Watan.
6	*Phytophthora* spde Bary	51	*Nectria humicola* P.Rama Rao.
7	*Pythium elongatum* V.D.Matthews.	52	*Nectriopsis graminis* Watanabe.
8	*Pythium spinosum* Sawada.	53	*Neocosmospora vasinfecta* E.F. Sm.
9	*Pythium echinulatum*.Pringsheim.	54	*Setosphaeria rostrata* K.J. Leonard.
10	*Pythium zingiberum* M.Takah.	55	*Soradaria fimicola* (Roberge ex Desm) Ces. & De Not.
	Chytridomycetes	56	*Thielavia terricola* Zopf.
11	*Allomyces anomalus* R. Emers.		**Deuteromycetes**
12	*Allomyces javanicum Kniep.*	57	*Acremonium implicatum* W.Gams.
13	*Allomyces moniliformis* Coker and Braxton.	58	*Acremonium strictum* W.Gams.
14	*Nowakowskiella elegans* (Nowak.) J. Schröt.	59	*Acrophialophora fusispora* Samson.
	Zygomycetes	60	*Alternaria alternate* (Fr) Keissl.
15	*Absidia corymbifera* (Cohn) Sacc. & Trotter.	61	*Alternaria brassicicola* Subramanian.
16	*Absidia cylindrospora* Hagem .	62	*Alternaria humicola* Oudem., Arch.
17	*Absidia fusca* Linnemann.	63	*Aspergillus candidus* Link.
18	*Absidia glauca* Hagem.	64	*Aspergillus awamori* Nakaz.
19	*Absidia repens* Van Tieghem.	65	*Aspergillus clavatus* Desm.
20	*Absidia spinosa* Lendn.	66	*Aspergillus deflectus* Fennell & Raper.
21	*Cunninghamella blakesleena* Lendn.	67	*Aspergillus clavatus* Desm.
22	*Cunninghamella echinulata* Thaxt. Ex Blakeslee.	68	*Aspergillus deflectus* Fennell & Raper.
23	*Gongronella butleri* (Lendn) , Peyronel & DalVesco.	69	*Aspergillus fischeri* Wehmer.
24	*Mortierella sp* Coem.	70	*Aspergillus flavipes* Thom & Church.
25	*Mucor hiemalis* Wehmer.	71	*Aspergillus flavus* Link.
26	*Mucor meguroense* Ts. Watan.	72	*Aspergillus fumigatus* Fresenius.
27	*Mucor plumbeus* Bonord.	73	*Aspergillus japonicas* Saito.
28	*Mucor varians* Pišpek.	74	*Aspergillus kanagawaensis* Nehira.
29	*Rhizopus stolonifer* Vuillemin.	75	*Aspergillus nidulans* Fennella &Raper.
30	*Rhizopus microspores* Schipper & Stapers.	76	*Aspergillus niger* Tiegh.
31	*Rhizopus oryzae* Went & Prinns, Geeri.	77	*Aspergillus ochraceus* Wilh.
32	*Syncephalastrum racemosum* Cohn ex J. Schrot.	78	*Aspergillus parasiticus* Speare.
33	*Zygorhynchus moelleri* Vuill.	79	*Aspergillus ruber* Thom & Church.
	Ascomycetes	80	*Aspergillus sulphureus* Thom & Church .
34	*Amorphotheca resinae* Parbery.	81	*Aspergillus sydowii* Thom & Church.
35	*Apiosoradaria verruculosa* Arx et Gams.	82	*Aspergillus terreus* Thom.
36	*Chaetomium amberpetense* R.Rao and Ram Reddy.	83	*Aspergillus unguis* Thom & Raper.
37	*Chaetomium globosum* Kunze.	84	*Aspergillus ustus* Thom & Church.
38	*Chaetomium gracile* Udagawa.	85	*Aspergillus versicolor* (Vuillemin) Tiraboschi.
39	*Chaetomium homopilatum* Omviik.	86	*Aspergilus funiculosus* Sm., Trans. Br.
40	*Chaetomium indicum* Corda.	87	*Aureobasidium pullulans* G.Amaud.
41	*Chaetomium osmaniae* RamaRao and Ram Reddy.	88	*Botrytrichum piluliferum* Saccand March.
42	*Chaetomium reflexum* Skolko & J.W.Grove.	89	*Camposporium laundonii* M.B.Ellis.
43	*Chaetomium solani* Rama Rao.	90	*Chaetospheria talbotti* Huges & Kendrik.
44	*Chaetomium spirales* Zopf.	91	*Chlamydomyces palmarum* E.W. Mason.
45	*Chetomium* sp.Chivers.		

Sl.No	Name of the fungus	Sl.No	Name of the fungus
92	*Cladosporium herbarum* (Pers) Link.	137	*Periconia byssoides* Pers.
93	*Cladosporium cladosporioides* G.A. de Vries.	138	*Periconia macrospinosa* Lefebvre & Aar.
94	*Cladosporium oxysporum* Berk & Curtis.	139	*Pestolotipsis mangifera* (Henn) Steyaert.
95	*Cladosporium spherospermum* Penz.	140	*Phialophora radicicola* Cain.
96	*Cladosporium variabile* G.A. de Vries.	141	*Phoma femeti* Brunaud, Bull.
97	*Colletotrichum dematium* (Pers),Grove..	142	*Phoma glomerata* Wollenw &Hochaptel.
98	*Curvularia lunata* (Wakker) Boedijn.	143	*Phoma herbarum* Cooke.
99	*Curvularia trifolii* (Kaufiman) Boedijin.	144	*Phoma nebulosa* (Pers) , Berk.
100	*Cylindrocladium torvum P.J. Anderson Bull.*	145	*Phoma* sp Sacc.
101	*Dichobotrys abundance* Hennebert.	146	*Phoma terricola* Boerema.
102	*Drechslera fromentacei* Leonard and Suggs.	147	*Pithomyces maydicus* (Sacc.) M.B. Ellis.
103	*Epicoccum purpurascens* Ehrenb.	148	*Pithomyces terricola* P.M.Kirk.
104	*Fusarium incarnatum* (Desm) Sacc.	149	*Pyrenochaeta globosa* T. Watanabe.
105	*Fusarium javanicum* Koord.,Verh.	150	*Pyrenochaetae* sp de Not.
106	*Fusarium oxysporum* Schlecht.	151	*Stachybotrys parvispora* S.Hughes.
107	*Fusarium poae* (Peck) Wollenw.	152	*Torula caligans* M.B.Ellis.
108	*Geosmithia lavendula*. Pitt.	153	*Torula herbarum (*Pers) Link.
109	*Geotrichum candidum* Link.	154	*Trichoderma atroviride Karst.,Finil.*
110	*Gliocladium roseum* Corda.	155	*Trichoderma aureoviride* Rita.
111	*Gliocladium viride* Matr.	156	*Trichoderma fertile* Bisset.
112	*Graphium penicillioides* Corda.	157	*Trichoderma harzianum* Rifai.
113	*Helicomyces* sp. Link.	158	*Trichoderma longibrachiatum* Rifai.
114	*Humicola fuscoatra* Traaen.	159	*Trichoderma pseudokoningii* Rifai.
115	*Macrophomina phaseolina* (Tassi) Gold.	160	*Trichoderma virens* Von Arx.
116	*Monodictys fluctuate* M.B. Ellis.	161	*Trichoderma viride* Pers.
117	*Myrothecium sp* Tode ex Fries.	162	*Tritirachium dependens Limber.*
118	*Nigrospora oryzae* Mason.	163	*Tritrirachium* sp *Limber.*
119	*Oidiodendron flavum* Szilvinyi.	164	*Verticillium terrestre (*Pers), Sacc.
120	*Paceliomyces* sp Bainier.	165	*Tritirachium dependens Limber.*
121	*Paciliomyces variotii* (Thom) Samson.	166	*Tritrirachium* sp *Limber.*
122	*Penicillium adametzii* Zaleski.	167	*Verticillium terrestre (*Pers), Sacc.
123	*Penicillium aurantiogriseum* Dierckx.		
124	*Penicillium bilaiae* Chalab.		Non Sporulating
125	*Penicillium camembertiati* Thom.	1	NSF White
126	*Penicillium chrysogenum*Thom.	2	NSF Brown
127	*Penicillium citrinum* Thom.	3	NSF Red color
128	*Penicillium corylophilum* Diercks.		
129	*Penicillium decumbens* Thom.		
130	*Penicillium digitatum* (Pers) Sacc.		
131	*Penicillium granulatum* Bainier.		
132	*Penicillium islandicum* Sopp.		
133	*Penicillium nigricans* Bainier. Ex Thom.		
134	*Penicillium restrictum* Gilman.		
135	*Penicillium* sp.Link.		
136	*Penicillium viridicatum* Westling		

Table 2. Physico-chemical parameters of Mattavara forest soils during the study period

Sl.No	Parameters	2013			2014			2015		
		Winter	Summer	Rainy	winter	Summer	Rainy	Winter	Summer	Rainy
1.	Rain fall in mm	70.33±1.52	225.3±2.51	1290±1.52	108.33±2.49	248 ±2.44	910.66±169	249.33±3.29	280±16.32	666.33±84.84
2.	Atmospheric temperature (^{0}C)	24±1.0	31±1.0	22.66±1.52	24.66±1.24	30.33±1.24	21.33±0.24	23.66±0.94	30±1.63	23±1.63
3.	Soil temperature (^{0}C)	20±1.0	30±1.0	23±1.0	20±0.81	25.66±2.49	21.66±1.24	21±1.63	29.33±2.02	22±1.63
4.	RH %	70±5.29	60±1.0	87.33±2.51	68.66±4.10	58.66±1.24	87.33±2.05	72.66±6.59	63±4.93	90.33±4.49
5.	Soil moisture %	18.99±0.37	13.28±0.28	25.14±0.74	22.54±0.016	14.96±0.052	28.65±0.04	19.81±1.20	16.43±1.66	20.18±2.08
6.	Soil P^H	4.72±0.58	5.46±0.45	7.14±0.02	4.45±0.05	6.80±0.027	7.83±0.02	5.45±0.792	7.42±0.409	5.88±0.777
7.	EC dSm^{-1}	0.018±0.007	0.183±0.07	0.11±0.01	0.14±0.04	0.24±0.045	0.11±0.250	0.373±0.372	0.18±0.01	0.15±0.008
8.	C %	2.53±0.026	2.98±0.03	2.81±0.03	2.10±0.015	2.55±0.05	2.75±2.03	2.86±0.087	2.50±0.029	2.47±0.31
9.	N Kg ha^{-1}	253.13±0.99	221.7±1.0	195.06±0.68	288.8±1.180	271.95±1.02	244.99±1.53	357.19±1.23	334.46±0.83	315.76±0.76
10.	P (Kg ha^{-1})	27±1.0	19±1.0	20±1.0	30.33±1.52	27.33±0.76	24±1.0	37.66±1.24	35±0.81	28.33±1.24
11.	K (Kg ha^{-1})	384.73±0.59	347.02±1.01	287.39±1.52	371.3±1.00	352.54±6.04	335.04±34.5	530.89±0.95	518.07±0.02	496.54±0.02
12.	S (Kg ha^{-1})	9±1.0	3±1.0	8±0.5	43±2.0	42.66±4.72	42±1.0	6.33±1.24	3.66±0.471	5.66±1.24
13.	Zn ppm	1.81±0.07	1.64±0.03	1.52±0.02	1.65±0.03	1.4±0.01	1.09±0.01	3.85±0.02	3.76±0.01	3.12±0.016
14.	Boron ppm	1.55±0.02	1.28±0.01	1.10±0.015	0.716±0.54	0.68±0.02	0.43±0.02	0.8±0.008	0.60±0.01	0.39±0.43
15	Fe ppm	30.09±0.63	28.13±0.47	24.99±0.59	30.39±0.79	27.97±0.37	23.60±0.60	29.11±0.02	26.12±0.033	23.66±0.40
16	Mn ppm	31.99±0.50	30.02±0.7	28.31±0.36	28±1.0	27±1.0	22±1.0	32.54±0.016	30.46±0.02	27.37±0.016
17	Cu ppm	1.6±0.05	1.53±0.10	1.36±0.01	1.19±0.05	1.10±0.06	0.84±0.05	2.07±0.05	1.8±0.0081	1.44±0.01
18	Ca ppm	5.3±0.1	4.72±0.02	5.54±0.04	5.74±0.04	8.16±0.25	6.61±0.07	3.06±0.008	5.43±0.20	6.2±0.08
19	Mg ppm	2.91±0.12	2.86±0.15	8.1±0.1	4.50±0.02	7.64±0.03	3.74±0.03	4.22±0.012	3.06±0.008	6.06±0.12

Table 3. Spearman's (r) Correlation Coefficient studies of soil physico-chemical properties with the diversity indices of species (Dominance and Shannon Index) in the different seasons from 2013 to 2015

	Seasons	R	AT	ST	RH	SM	pH	EC	C	N	P	K	S	Zn	B	Fe	Mn	Cu	Ca	Mg	Silt	Sand	Clay
Dominance	Rainy	0.99*	0.36	0.54	0.46	0.65	0.60	-0.60	0.88	-1.0*	-0.97*	-0.89	0.08	-0.71	0.75	0.89	0.21	-0.09	-1.00*	0.49	-0.52	-0.94*	0.97*
	Summer	-0.73	0.98*	0.52	-1.0*	-0.41	-0.56	-1.0*	0.74	-0.43	-0.51	0.02	-0.90	0.13	0.92*	0.03	0.92*	0.56	-1.00*	-0.82	0.67	0.40	-1.00*
	Winter	-0.40	1.00*	-0.98*	0.32	-0.89	0.39	-1.00*	0.34	-0.53	-0.62	-0.13	-0.72	-0.12	0.93*	0.00	0.73	0.35	-0.99	-0.99*	0.89	-0.98*	0.93*
	Seasons	R	AT	ST	RH	SM	pH	EC	C	N	P	K	S	Zn	B	Fe	Mn	Cu	Ca	Mg	silt	Sand	Clay
Shenon Index	Rainy	0.94*	-0.10	0.86	0.02	0.25	0.18	-0.90	0.58	-0.83	-0.77	-0.60	-0.37	-0.32	0.96*	1.0*	0.62	0.36	-0.86	0.83	-0.08	-0.70	0.77
	Summer	-0.73	0.98*	0.52	-1.0*	-0.42	-0.56	-0.99*	0.75	-0.43	-0.51	0.01	-0.90	0.12	0.93*	0.04	0.92*	0.56	-1.00*	-0.82	0.67	0.40	-1.00*
	Winter	0.83	-0.84	0.72	0.24	0.50	0.16	0.84	0.21	0.90	0.94*	0.64	0.23	0.63	-0.98*	-0.54	-0.25	0.21	0.92*	0.91*	-1.00*	0.72	-0.59

Note;*Correlation is significant at the level *P=0.05 (Probability at 5%), **P=0.01(Probability at 1%), R- Rain, AT- Atmospheric Temperature(^{0}C), RH- Relative humidity(^{0}C), SM- Soil moisture(^{0}C), SpH – Soil PH, EC- Electrical conductivity(dSm^{-1}), C- Organic Carbon(%), N- Nitrogen(kg.ha-1), P- Phosphorus(kg.ha-1), K- Potassium(kg.ha-1), S- Sulphur(kg.ha-1), Zn- Zinc(ppm), B- Boron(ppm), Fe- Iron(ppm), Mn-Manganese(ppm), Cu- copper(ppm), Ca, Calcium(ppm), Mg- Magnesium. (ppm).

Fig.1. Graphical representation of total number of colonies recorded in Mattavara forest during different seasons from 2013 to 2015

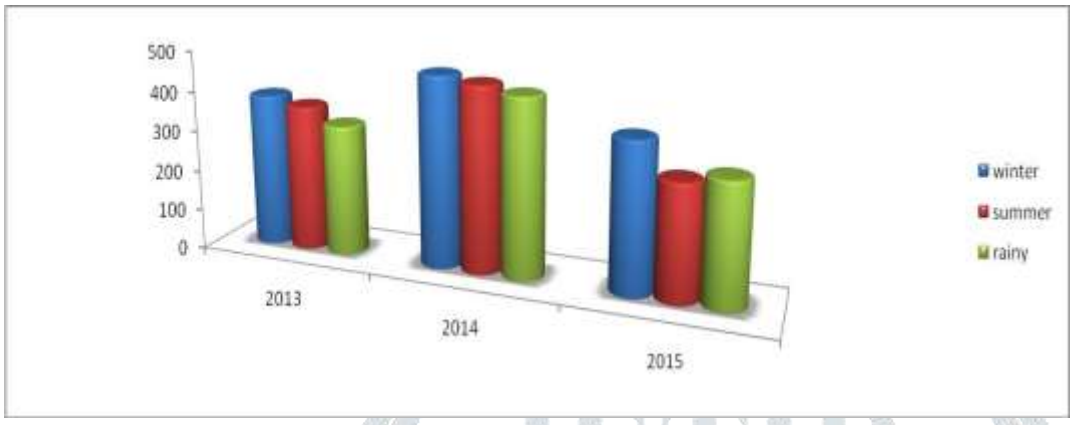
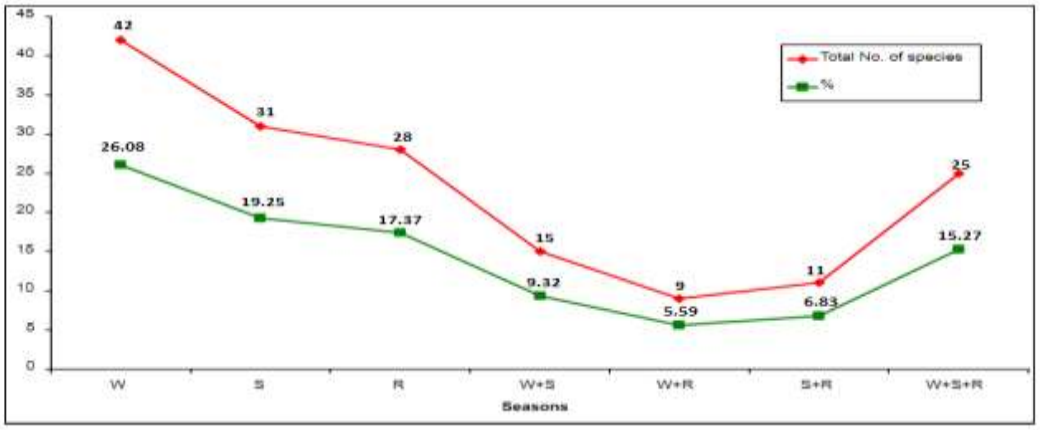


Fig. 2.. Total number and percentage of fungal species recorded during winter, summer and rainy season from 2013 to 2015.



Conclusion

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It can be concluded from the above data that season plays an important role by way of fluctuating in physicochemical factors and biological condition. Among all physicochemical parameters Rainfall is the main key factor results in marked seasonal variation in distribution of microfungal population number by altering the moisture content, temperature, humidity, pH, micro and macro nutrients status of the soil in the study area.

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