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Variation in extramural aeromycoflora of the Lake of Futala, Nagpur (M.S.) India

Bhajbhuje MN[1] and Akare Anjali[2]

[1]Department of Botany, Jawaharlal Nehru Mahavidyalaya, Wadi, Nagpur- 440 023 (M.S.) India
[2]Post Graduate Teaching Dept. of Botany, RTM Nagpur University, Nagpur- 440 033 (M.S.) India
*Corresponding author e-mail: dr_mnbhajbhuje@rediffmail.com

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ABSTRACT

In the present survey, variation in aeromycoflora from various locations of the Lake of Futala area was recorded for a month at an interval of a week employing culture plate exposure method. Altogether 3187 fungal colonies falls under 18 genera and 37 species have been confined on agar jelly. A count of 15 genera was encountered in first and second week of survey and genera number was recorded declined to 12 and 10 in third and fourth week of survey respectively. A greater count of species was encountered on agar jelly in second and third week and least count in fourth week of survey. The extramural fungal airspora was predominant in second week contributing 31.2 per cent and it was recorded gradual decline to 25.9 per cent in first week and 22.8 per cent in fourth week. Least concentration was encountered in third week contributing 20.2 per cent airspora. Deuteromycota was the most predominant group exhibiting in highest concentration in second week contributing 14.6 per cent airspora followed by Ascomycota and Zygomycota. Least concentration of fungal airspora was reported for Oomycota in all weeks of a month during survey. The variation in concentration of fungal flora in winter and pre-winter season particularly in the months of September and October may attributed to fluctuating weather and relative humidity, which supports fungal growth of same group and act inhibitory for others

Keywords: Aeromycoflora, outdoor, saprobic, microbes, allergy, asthma, extramural.

INTRODUCTION

Aeromycoflora is comparable most prominent allergen bioparticulates that includes the heterotrophic microfungal propagules on many different parts of the world, can survive in the wet or dry environment through scavenging nutrients from the atmosphere (Sharma, 2010). Prevalence of fungal propagules, volatiles and mycotoxins in the environment are implicated to cause allergic symptoms in all segments of the population (Chelak and Sharma, 2012), of them more than 80% microfungal genera have been associated with respiratory disorders (Ghosh et al., 2011). Most of the allergenic microfungi belong to Ascomycotina and Deuteromycotina with a few in Basidiomycotina (Sharma et al, 2011).

The propagation of spores related to existing environmental factors like temperature and humidity while their liberation and dispersion related to light, wind velocity and other conditions (Sharma, 2010). The spores' liberation of *Aspergilli* and *Penicilli* were favored by high air humidity and while those of *Alternaria, Cladosporium* and *Helminthosporium,* were liberated mechanically by the action of wind (Ianovici, 2008). Spore dispersal of Ascomycotina is therefore favored by high relative humidity and low temperature while slightly increasing temperature with low humidity supports spore dispersal of Deuteromycotina. The occurrence of such conditions at different times in different geographical regions may help to explain differences in the observed periodicities (Chelak and Sharma, 2012). Deuteromycotina fungus, *Alternaria solani* reported a major constituent of fungal bio-aerosol (Sharma, 2010). *Cladosporium* was most correlated with meteorological parameters, may be attributed dry conidia in chains easily carried through air hence dispersion of spores was more influenced by meteorological parameters than *Alternaria* spores (Ianovici, 2008).

The Lakes are visualized as uniform mass of water having physical, chemical and biological characteristics (Wikipedia, 2018). The Lake situated near Futala, is surrounded by wetlands, farmlands, forests, gardens, and many shops and a landscaped cowpat on one side. Several visitors report the place in early morning to benefit in term of good health and others can spend a couple of hours in late evening for the peace, relaxation and for enjoyment. It is famous for Ganesh Chaturthi Utsav; much other use and for immersion of many of the idols of Nagpur. Every day tons of garbage is deposited on the shore line of Lake, consisting of biodegradable and non-biodegradable wastes. South-east region of the Lake is covered by slums and used for dumping garbage, poly bags, waste papers and food waste near the edges of Lake. Moreover, drain water is directly allowed to release into the Lake. Due to these activities, shore line area is intensely polluted.

Diverse group of fungal species are reported to be the major causal agents of respiratory disorders of human beings and also important agents of degradation of cellulosic and non-cellulosic material in outdoor environment (Turkel and Bhajbhuje, 2017). The distribution of environmental microfungi in Lake Areas may differ periodically because of diversity in vegetation, climatic fluctuation and heavy load of pollutants in the extramural environment. Thus there is great need of understanding aerobiological studies of extramural environment from various locations of Lake of Futala area. Presently, prevalence of aeromycoflora from outdoor environment has so far not been reported earlier from this place, hence it seemed to be worthwhile to undertake a more comprehensive and systematic study of the diversity of aeromycoflora of Lake of Futala during winter season.

MATERIALS AND METHODS

Variation in aeromycoflora of Lake of Futala area has been studied for a period of month at an interval of week employing culture plate method. A sterile Potato Dextrose Agar medium composed of 200 gm peeled potato, 20 gm dextrose and 20 gm agar in a liter of distilled sterile water was used for cultivating airborne fungal spores. An aqueous solution of streptomycin sulphate was added to medium preventing the growth of bacteria (Kayarkar and Bhajbhuje, 2014). A sterile petriplates containing 10 ml PDA nutrient medium were sealed by sellotape. The petriplates containing medium were exposed for 10 minutes in triplicates at each of the location of the Lake of Futala area at an interval of a week for a month (September 2017). The exposed petri plates were again sealed by sellotape and incubated for 3-5 days at room temperature in a laboratory.

On the basis of macro-morphological characteristics, the fungal colonies appeared on surface of agar jelly were recorded for number and their distribution on petri plates. Micro- and macro-morphology, reverse and surface coloration of colonies grown in Czapek's medium were considered for species identification. The isolates are authenticated by authority. The per cent distribution of isolates and their incidence was recorded (Turkel and Bhajbhuje, 2017).

RESULTS AND DISCUSSION

A survey of extramural environment of the Lake, Futala area, near Telankhedi Garden, Nagpur, has been conducted for a month (Sep. 2017) at an interval of a week employing the culture plate exposure method and results are presented in Table 1.

In the present survey, population of altogether 3187 fungal colonies classified under 18 genera and 37 species were recorded by culture plate exposure

Table 1: Distribution of Aeromycoflora of Lake of Futala area, Nagpur for a month

S. N.	Fungal organism	Number of fungal colonies				Total count	% Contribution	
		Week I	Week II	Week III	Week IV		Species	Genus
A.	**Oomycota**	5	8	12	13	38	1.20	1.20
1	*Phytophthora infestans* (Mont.) de Bary	5	-	12	-	17	0.53	1.20
2	*Phytophthora sp.*	-	8	-	13	21	0.66	
B.	**Zygomycota**	54	45	157	82	338	10.6	10.6
3	*Blackeslea trispora* Thaxter	21	-	-	26	47	1.47	1.47
4	*Mucor mucedo* de Bary & Woron	-	-	42	16	58	1.82	3.58
5	*M. pusillus* Lindt	15	21	20	-	56	1.76	
6	*Rhizopus microspores* Tiegh	-	-	42	25	67	2.10	5.55
7	*R. stolonifer* (Eh.Ex.Rr.) Lind	18	24	53	15	110	3.45	
C.	**Ascomycota**	358	432	186	262	1238	38.9	38.9
8	*Aspergillus amstelodami* (Mang)Thom & Church	15	7	-	-	22	0.70	37.53
9	*A. candidus* Link	-	3	16	-	19	0.60	
10	*A. carneus* (Tie.) Bloch	-	-	11	-	11	0.35	
11	*A. flavus* Link.	133	55	51	21	260	8.16	
12	*A. fumigatus* Fres.	15	29	9	4	57	1.80	
13	*A. nidulans* G Winter	-	-	8	6	14	0.44	
14	*A. niger* Van Tieghem	133	249	74	206	662	20.8	
15	*A. ochraceus* Wilh	-	69	-	-	69	2.17	
16	*A. sulphureus* (Fres.)T&C	6	-	-	-	6	0.20	
17	*A. terreus* Thom.	-	-	9	-	9	0.28	
18	*A. versicolor* Tiraboschi	22	11	8	25	66	2.07	
19	*Penicillium citrinum* (C & S) Pitt.	-	9	-	-	9	0.30	1.37
20	*P. notatum* Crulina	34	-	-	-	34	1.07	
D.	**Basidiomycota**	-	-	-	-	-	-	
E.	**Deuteromycota**	368	468	184	248	1268	39.8	39.8
21	*Alternaria alternata* Keissler	21	46	14	-	81	2.54	2.67
22	*A. triticina* Prasada & Prabhu	-	-	4	-	4	0.13	
23	*Cladosporium cladosporioides* (Fresen.) de Vries	134	145	26	68	373	11.7	12.55
24	*C. herbarum* (Pers.) Link	-	27	-	-	27	0.85	
25	*Curvularia lunata (*Wakker) Boedijn.	43	46	14	49	152	4.77	5.43
26	*C. ovoides* (H & N.) Munt	-	-	-	7	7	0.22	
27	*C. brachyspora* Boedijn	-	14	-	-	14	0.44	
28	*Drechslera rostrata* (Drechsler) Richardson & Fraser	-	23	-	-	23	0.72	0.72
29	*Fusarium oxysporum* Schlecht.	-	8	5	-	13	0.40	0.53
30	*F. semitectum* Berk & Ravenel	4	-	-	-	4	0.13	
31	*Helminthosporium tetramera* McKinney	-	32	9	-	41	1.30	1.30
32	*Microdochium dimerum* (Penz.) Arx	25	-	-	-	25	0.78	0.78
33	*Nigrospora oryzae* (Berk & Broome) Petch	-	24	-	-	24	0.75	0.75
34	*Torula herbarum* (Pers.) Link	33	-	-	-	33	1.04	1.04
35	*Trichoderma viride* Pers.	108	103	112	124	447	14.0	14.0
F.	**Other types**	39	42	104	120	305	9.60	9.60
36	*Sterile white mycelium*	18	21	59	62	160	5.00	5.00
37	*Sterile black mycelium*	21	21	45	58	145	4.60	4.60
	Genera/Species	15(20)	15(23)	12(22)	10(16)	18(37)		
	Sum of total colonies	824	995	643	725	3187	100.1	
	Percent contribution	25.9	31.2	20.2	22.8	100.1		

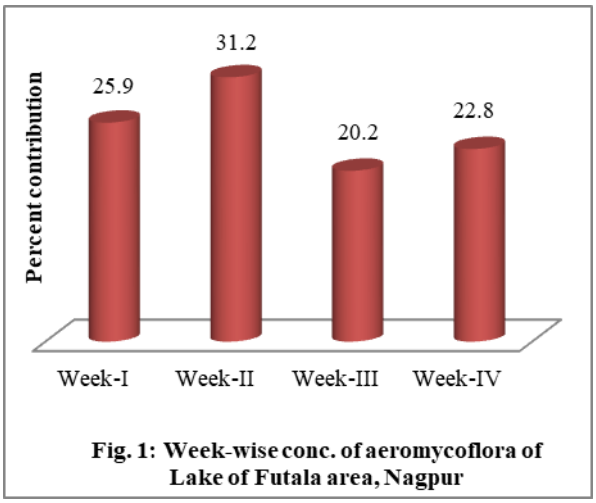

Fig. 1: Week-wise conc. of aeromycoflora of Lake of Futala area, Nagpur

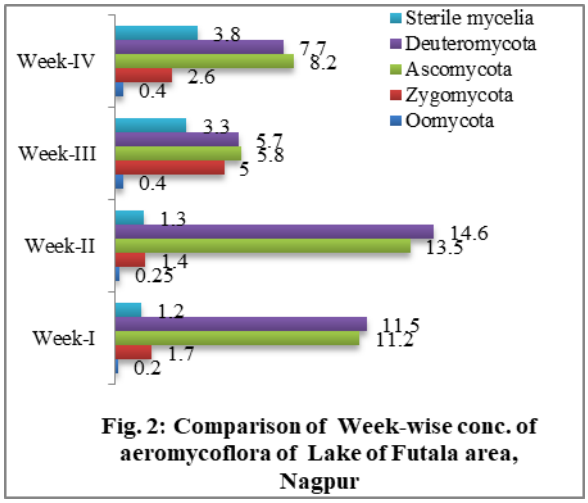

Fig. 2: Comparison of Week-wise conc. of aeromycoflora of Lake of Futala area, Nagpur

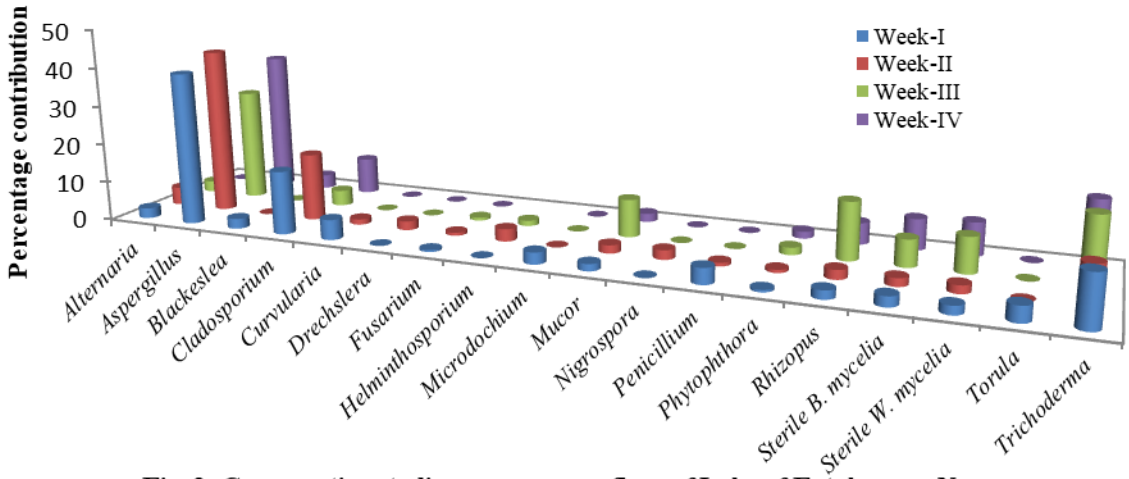

Fig. 3: Comparative studies on aeromycoflora of Lake of Futala area, Nagpur

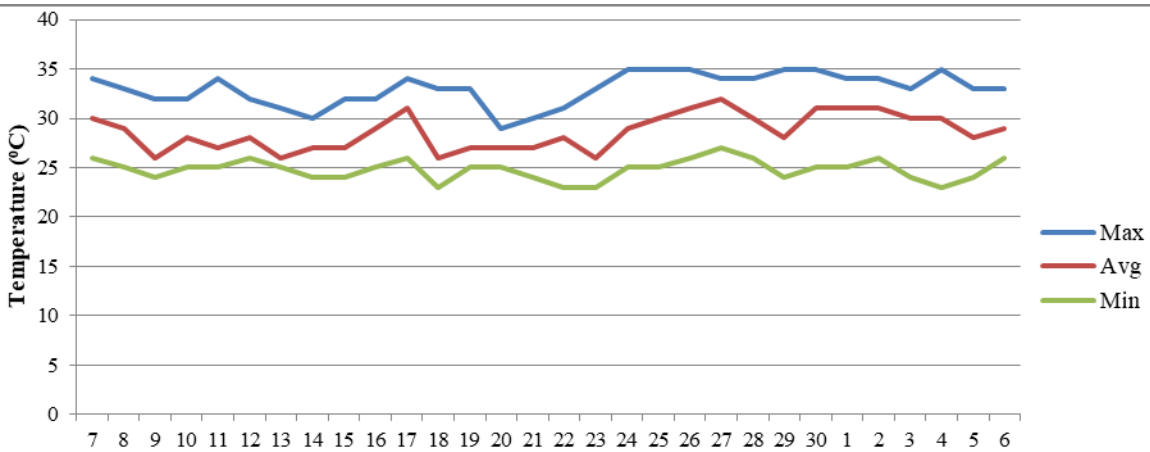

Fig. 4: Record of minimum, maximum and daily mean temperature of the sampling sites

method (Table 1). Of the total 3187 colonies encountered, members of Deuteromycota and Ascomycota were reported predominant in the extramural environment followed by Zygomycota. Least colony count was encountered for Oomycota. Basidiomycota member did not appear on agar jelly (Table 1).

The isolation of aeromycoflora of an area understudy was carried out at an interval of a week from various locations of Lake for a month. The environment of the Lake was reported to be heavily contaminated by airborne fungal spores. Mycological analysis revealed an existence of air borne fungal propagules in greater concentration in second week contributing 31.2 per cent of total fungal airspora followed by 25.9 per cent airspora in first week. The fungal airspora was reported to be declined in third week and fourth week, contributing 20.2 and 22.8 per cent airspora respectively (Fig. 1). These results are in confirmation with earlier findings (Ghosh et. al, 2011; Chelak and Sharma, 2012; Kayarkar and Bhajbhuje, 2014).

Deuteromycota was the most predominant group exhibiting in highest concentration in second week contributing 14.6 per cent airspora followed by 11.5 per cent airspora in first week. Ascomycota was second highest group contributing 13.5 per cent airspora in second week followed by 11.3 per cent airspora in first week. Zygomycota contributed 5 per cent airspora of the total in third week and it was declined to 2.6 per cent in forth week. Sterile mycelia contributed 3.8 per cent and 3.3 per cent airspora in forth and third week respectively. Least concentration of fungal airspora was reported for Oomycota in all weeks of a month during survey (Fig. 2).

Considering diverse fungal population count in weekly period of survey for a month, the fungal isolates may categorized into six types viz., (a) throughout a month, (b) in first week only, (c) in second week only, (d) in third week only, (e) in fourth week only and (f) rare without showing any specificity to time of recurrence. A fungal population of 37 diverse isolates representing 18 genera was seemed to be prevailing in the environment of the Lake understudy. Of these, a population of 13 isolates representing 9 genera, viz., *Mucor pusillus*, *Rhizopus stolonifer*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. versicolor*, *Alternaria alternata*, *Trichoderma viride*, *Curvularia lunata*, *Cladosprium cladosporioides*, *Sterile white mycelium* and *Sterile black mycelium* were encountered on agar plates throughout a month from the environment of the Lake understudy. Among these *Aspergillus niger* appeared predominant contributing 20.8 per cent airspora while *Trichoderma viride* and *Cladosporium cladosporoides* were reported sub-dominant (Fig. 3).

Variation in count of fungal isolates was recorded during every week of survey. Greatest count of isolates was recorded in the second week while least count in fourth week (Fig. 3). Half of the isolate are rare in the studied aeromycoflora. Half of the isolates appeared only once in a period of month. The isolates, *Aspergillus niger, Alternaria alternata, Cladosporium cladosporioides, Trichoderma viride* and *sterile mycelia* were contributed comparatively highest airspora in the second week of survey. *Aspergillus flavus* was most dominant in the first week contributing highest airspora. The genera *Mucor* and *Rhizopus* were reported highest count in the third week while *Curvularia lunata* and *Aspergillus versicolor* encountered the highest count in the fourth week compared to air spora of other weeks (Fig. 3).

The isolates *Rhizopus stolonifer*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. versicolor*, *Alternaria alternata*, *Trichoderma viride*, *Curvularia lunata*, *Cladosporium cladosporioides*, *Sterile white mycelium* and *Sterile black mycelium* existed in environment for all the sites in all weeks. *Fusarium oxysporum, A. candidus*, *Helminthosporium tetramera* existed in the second and the third week. The isolates *Mucor mucedo, Rhizopus microsporus* and *Aspergillus nidulans* encountered in the third and fourth week. *A. sulphureus*, *Penicillium notatum, Fusarium semitectum* and *Torula herbarum* encountered in the first week only while *Curvularia brachyspora, Drechslera rostrata*, *Penicillium citrinum* and *Nigrospora oryzae* detected in the second week only. *Aspergillus carneus*, *A. terreus* and *Alternaria triticina* dominated in the third week and *Curvularia ovoides* found only in the fourth week. *Phytophthora infestans* encountered only in the first and the third week and *Phytophthora sp.* found in the second and the fourth week while *Blackeslea trispora* detected in the first and the fourth week (Fig. 3).

The peak period of fungal spore concentrations was recorded in the second week of survey (15^{th}-21^{st} Sept. 2017). The moderate climatic conditions during this time with temperature ranging between 32^0C (max.) to 24^0C (min.) and relative humidity (79%) supports for dissemination of fungal spores in the environment.

Marginal reduction in fungal spore concentration was recorded in the third week (22nd-28th Sept, 2017) may attributed to fluctuation or marginal declining of minimum temperature (23^0C-30^0C). Considerable reduction in the aeromycoflora was recorded in the fourth week (29th-6th Oct. 2017) of survey, may attributed to moderately less humidity (56%) and maximum temperature enhanced to 26^0C-34^0C in the fourth week of survey (Fig. 4). Prevalence of rainy weather and less humidity in this period may perhaps become barrier for rapid multiplication, so growth rate slightly declined for majority of the microfungal organisms. It seems also possibly fluctuating temperatures and relative humidity responsible to inhibit fungal growth.

The fungal organisms require more than 65 per cent humidity for their growth providing nutrient rich substrates (Kayarkar and Bhajbhuje, 2014). Most of the spores of fungal origin remain existed predominantly in the environment during the rainy season (Sept.- Oct) when temperature ranges between 20-30ºC and relative humidity remains 75 per cent or above (Mishra and Deshmukh, 2009). The environment of the Lake provides maximum humidity for the growth of airborne fungal spores.

Majority of the researchers proved that optimum temperature, high moisture content, nutritive substrate creates favorable microclimates for a profuse growth, proliferation and sporulation of airspora leading to higher population of fungal species (Kayarkar and Bhajbhuje, 2014). Variation in these factors, particularly temperature results to increased dormancy and also inhibition of fungal growth (Bhajbhuje, 2015).

The variation in concentration of fungal flora in pre-winter season particularly in the months of September and October may attributed to fluctuating weather and relative humidity, which supports fungal growth of same group and act inhibitory for others. It seems also possibly fluctuating temperatures and relative humidity responsible to inhibit fungal growth. Prevalence of rainy weather and less humidity in this period may perhaps become barrier for rapid multiplication, so growth rate slightly declined for majority of the microfungal organisms (Katre, 2016).

Majority of the airborne fungal propagules including spores are potential allergen. Hence, outdoor aeromycological surveys help considerably to locate the sources of spores, their identification, concentration and seasonal variation. Thus, such information provides basic data for the treatment of sensitive individuals suffering from an allergy. Data obtained from such a survey help to obtain spore calendar for the allergens, their avoidance and management strategies (Mishra and Deshmukh, 2009).

CONCLUSION

A fluctuation in a set of climatic condition; changes in physical and chemical properties of lake, humidity, temperature are conductive for the growth of the fungal organisms accelerating the deterioration process. Significant concentration of fungal propagules has been reported in second week and it was reported decline in subsequent weeks of the survey may attributed to fluctuation of set of climatic condition surrounding the lake. Majority of the fungal isolates involved in biodegradation and biodeterioration process of cellulosic and non-cellulosic material provided favourable climate that helps reducing the content of some biodegradable pollutant. The fluctuation in climatic condition resulted changes in rate of biodegradation of biodegradable pollutants.

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