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Variation in aeromycoflora of Seminary Hills, Nagpur (M.S.) India

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ABSTRACT

Aeromycological survey was conducted for various locations of seminary hills area of Nagpur for winter season employing culture plate exposure method. A count of 4311 fungal colonies falls under 19 genera and 37 species have been confined on agar jelly during survey. Of these, a count of 13 genera was encountered in the month of September but its count was recorded enhance to 19 subsequently during December to February. A greater count of species was encountered on agar jelly in December and January while least count was recorded during September. Moderate genera count was confined in the month of October and November. The gradual increasing trend of fungal airspora was recorded from September to December and it was predominant in the January, contributing 31.3 percent of total airspora then it was declined to 11.3 percent in February. Deuteromycota was the most predominant group exhibiting in highest concentration of fungal propagules in the environment contributing 42.9 percent airspora followed by Ascomycota with 39.9 percent airspora. Zygomycota contributed 8.9 percent fungal airspora while least concentration was reported for Oomycota in all months during survey. The variation in concentration of fungal flora in winter season may be attributed to fluctuating weather and relative humidity, which supports fungal growth of same group and act inhibitory for others.

Keywords: Aeromycology, fungal airspora, extramural, micro-fungal, allergy, asthma

INTRODUCTION

Bio-particulates are considered major air contaminant of the atmosphere that includes the prominent allergens, active micro-fungal propagules and can survive in the wet or dry environment through scavenging nutrients from the atmosphere (Admas et al, 2013). Their prevalence in the environment are implicated to cause allergic symptoms in all segments of the population (Ianovici, 2008), of them more than 80% microfungal genera have been associated with respiratory disorders (Ghosh et al., 2011).

The propagation of fungal microbes in the existing environment relates to temperature and humidity while their liberation and dispersion concerns to light, wind velocity and other conditions (Sharma, 2010). The dispersal of ascomycetous spores 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 (Ianovici and Tudorica, 2009)

Seminary Hills of Nagpur is a green, silent area, equipped with all basic amenities, low traffic and good for retired agents since they can spend time relaxing in cool environment and give enough time to self-enjoying in the gardens herein. Several visitors visit the place in early morning to benefit in term of good health and others can spend a couple of hours in evening for the peace, relaxation and for enjoyment. Moreover, every day tons of garbage is deposited nearer to this area, consisting of biodegradable and non-biodegradable wastes hence due to these activities it gets polluted (Wikipedia, 2020)

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 (Akare and Bhajbhuje, 2018). The distribution of environmental micro fungi in seminary hill area, Nagpur differ periodically because of diversity in vegetation, climatic fluctuation and heavy load of pollutants in the environment. Thus there is great need of understanding aeromycological studies of extramural environment from various locations seminary hills, Nagpur Literature survey reveals that aeromycological studies so far not been conducted earlier from this area, hence it seemed to be worthwhile to undertake a more comprehensive and systematic study aeromycoflora of seminary hills area of Nagpur during winter season.

MATERIALS AND METHODS

Aeromycoflora of seminary hill area, Nagpur has been studied during winter (September to February 2020) employing culture plate method (Menghare and Bhajbhuje, 2019) A sterile sealed petri-plates containing 10 ml PDA nutrient jelly were exposed for 10 minutes between 11.45 am to 12.15 pm in triplicates at various locations of survey area at an interval of a month. The exposed petri plates were again sealed by sellotape and incubated for 3-5 days at room temperature in a laboratory (Bhajbhuje and Akre, 2018).

The fungal colonies appeared on surface of agar jelly were recorded for number and their distribution on petri plates. The species were identified on basis of micro- and macro-morphology, reverse and surface coloration of colonies on Czapek's Dox nutrient jelly. The isolates are authenticated by authority. The per cent distribution of isolates and their incidence was recorded for each month (Menghare and Bhajbhuje, 2019).

RESULTS AND DISCUSSION

Aeromycological survey of seminary hills area Nagpur, has been conducted during winter season September 2019 to February 2020 employing the culture plate exposure method. During survey a count of 4311 fungal colonies classified under 19 genera and 37 species were recorded (Table 1). Members of Deuteromycota were confined predominant with a count of 1851 colonies followed by Ascomycota with 1721 colonies. A count of 386 colonies was recorded for zygomycota while least colony count was confined to Oomycota. Basidiomycota member did not appear on agar jelly (Table 1).

The environment of the survey area was reported to be supportive for propagation of airborne fungal spores. Aeromycological analysis revealed an existence of air borne fungal propagules in greater concentration in January contributing 31.3 per cent of total fungal airspora followed by 21.6 per cent airspora in December. The least fungal airspora was confined in September, contributing 6.9 per cent airspora. After initial period of survey, September onwards, aeromycoflora was reported to increase in each subsequent month and reached greatest in January. Subsequently, it was reported decline to 11.3 per cent in February (Fig. 1). These results are in confirmation with earlier findings (Vijayalaxmi and Jeyachandran, 2010; Verma et al, 2013; Bhajbhuje, 2015;Yerne & Bhajbhuje, 2019). Menghare and Bhajbhuje (2019) reported the greater count of air fungal contaminant in the month of January in the environment of Satpuda Botanical Garden, Nagpur.

Table 1: Distribution of Aeromycoflora of Seminary Hill area, Nagpur

Sr. no.	Fungal organism	Number of fungal colonies							Total count	Per cent Contribution
		Sept	Oct	Nov	Dec	Jan	Feb		Species	Genus
A	**Oomycota**	**2** (0.05)	**1** (0.02)	**2** (0.05)	**11** (0.26)	**14** (0.33)	**4** (0.09)	**34** (0.79)	**0.79**	0.79
1	*Phytophthora infestans* (Mont.) de Bary	2	1	2	9	10	2	26	0.60	0.61
2	*Pythium aphanidermatum*(Els.) Fitz	-	-	-	2	4	2	8	0.19	0.19
B	**Zygomycota**	**15** (0.34)	**40** (0.92)	**41** (0.95)	**102** (2.37)	**131** (3.04)	**57** (1.32)	**386** (8.95)	8.95	8.95
3	*Mucor mucedo* de Bary & Woron	2	-	8	24	37	4	75	1.74	4.36
4	*M. pusillus* Lindt	3	18	11	27	32	22	113	2.62	
5	*Rhizopus microspores* Tiegh	2	-	3	22	35	8	70	1.62	4.58
6	*R. stolonifer* (Eh.Ex.Rr.) Lind	8	22	19	29	27	23	128	2.96	
C	**Ascomycota**	**131** (3.0)	**216** (5.0)	**325** (7.5)	**375** (8.7)	**524** (12.2)	**150** (3.5)	**1721** (39.9)	**39.9**	39.9
7	*Aspergillus amstelodami* (Mang)Thom & Church	2	1	6	3	5	1	18	0.42	37.41
8	*A. candidus* Link	-	-	3	12	15	2	32	0.74	
9	*A. carneus* (Tie.) Bloch	1	-	-	8	13	-	22	0.51	
10	*A. flavus* Link.	54	43	61	74	91	58	381	8.84	
11	*A. fumigatus* Fres.	8	16	32	19	14	12	101	2.34	
12	*A. nidulans* G Winter	-	-	-	8	6	2	16	0.37	
13	*A. niger* Van Tieghem	61	133	187	207	302	58	948	21.99	
14	*A. ochraceus* Wilh	-	-	9	8	14	3	34	0.79	
15	*A. sulphureus* (Fres.)T&C	2	6	-	8	8	2	26	0.60	
16	*A. versicolor* Tiraboschi	1	3	5	9	12	5	35	0.81	
17	*Penicillium citrinum* (C & S) Pitt.	-	14	11	8	25	3	61	1.41	2.15
18	*P. notatum* Crulina	2	-	9	8	11	2	32	0.74	
19	*Phoma glomerulata* (Corda) W & H	-	-	2	3	8	2	15	0.35	0.35
D	**Basidiomycota**	-	-	-	-	-	-	-	-	
E	**Deuteromycota**	128 (2.9)	232 (5.4)	312 (7.2)	369 (8.6)	578 (13.4)	232 (5.4)	1851 (42.9)	1851 (42.9)	42.89
20	*Alternaria alternata* Keissler	7	21	46	14	28	12	128	2.96	5.88
21	*A. solani*(E &M) Jones & Grout	12	14	14	18	39	14	111	2.57	
22	*A. triticina* Prasada & Prabhu	-	-	-	4	8	3	15	0.35	
23	*Cladosporium cladosporioides* (Fresen.) de Vries	31	74	76	86	98	68	433	10.04	12.01
24	*C. herbarum* (Pers.) Link	11	10	17	15	24	8	85	1.97	
25	*Curvularia lunata (*Wakker) Boedijn.	32	43	46	54	89	34	298	6.91	8.52
26	*C. ovoides* (H & N.) Munt	2	6	6	9	14	8	45	1.04	
27	*C. geniculata* (T & E) Boedijn	-	-	4	7	12	2	25	0.58	
28	*Drechslera rostrata* (Drechsler) Richardson & Fraser	-	5	12	19	22	9	67	1.55	1.55
29	*Fusarium oxysporum* Schlecht.	8	12	18	25	32	11	106	2.46	4.01
30	*F. semitectum* Berk & Ravenel	2	4	7	18	24	12	67	1.55	
31	*Helminthosporium tetramera* McKinney	-	-	5	9	32	11	57	1.32	1.32
32	*Microdochium dimerum* (Penz.)Arx	-	2	-	12	25	9	48	1.11	1.11
33	*Nigrospora oryzae* (Berk & Broome) Petch	-	-	14	15	22	8	59	1.37	1.37
34	*Torula herbarum* (Pers.) Link	1	3	5	12	33	9	63	1.46	1.46
35	*Trichoderma viride* Pers.	22	38	42	52	76	14	244	5.66	5.66

Table 1: Continued…

Sr. no.	Fungal organism	Number of fungal colonies							Total count	Per cent Contribution
		Sept	Oct	Nov	Dec	Jan	Feb		Species	Genus
F	**Other types**	**20**	**36**	**42**	**74**	**101**	**46**	**319**	**319**	7.39
36	*Sterile white mycelium*	8	14	19	39	52	24	156	3.61	3.61
37	*Sterile black mycelium*	12	22	23	35	49	22	163	3.78	3.78
	Genera/Species	13/25	15/25	17/31	19/37	19/37	19/36	19/37	-	-
	Sum of total colonies	296	525	722	931	1348	489	4311	-	-
	Percent contribution	6.9	12.2	16.7	21.6	31.3	11.3	100	100	100

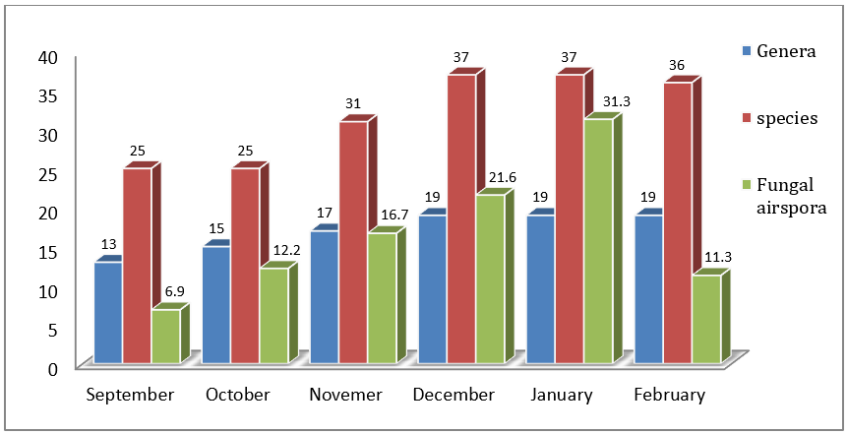

Fig. 1: Distribution of genera, species & fungal airspora during winter season

Deuteromycota was reported the most predominant group exhibiting in highest concentration contributing 42.9 per cent while least concentration was confined to Oomycota. Ascomycota was second highest group contributing 39.9 per cent airspora followed by Zygomycota contributing 8.9 per cent of total airspora. Sterile mycelia contributed 3.6 and 3.8 per cent airspora during the period of survey (Fig. 1).

A fungal population of 37 diverse isolates representing 19 genera was seemed to be prevailing in the environment of the area understudy. Aspergilli dominated the airspora contributing 37.4 per cent colonies followed by species of *Cladosporium* confined with 12.0 per cent of the total airspora. Members of Zygomycota, *Mucor* and *Rhizopus* as well as mitosporic genera such as *Alternaria* and *Curvularia* were existed in moderate concentration in the environment of survey area. A population of 9 isolates representing 6 genera, viz., *Aspergillus niger, A. flavus, A. fumigatus, Alternaria solani, A. alternata, Cladosporium cladosporoides Curvularia lunata, Fusarium oxysporum and Trichoderma viride* were reported predominant in the environment throughout survey period. Among the Aspergilli, *Aspergillus niger* appeared predominant contributing 21.9 per cent airspora while *Cladosporium cladosporoides*, *Curvularia lunata* and *Trichoderma viride* were reported sub-dominant with 10.0, 6.9, 5.6 per cent airspora respectively (Fig. 1).

The peak period of fungal spore concentrations was recorded in the month of January. The moderate climatic conditions during this time with temperature ranging between 22^{0}C (max.) to 18^{0}C (min.) and relative humidity (85%) supports for dissemination of fungal spores in the environment. Marginal reduction in fungal spore concentration was recorded in the month of November and December may attribute to fluctuation or marginal declining of minimum temperature. Considerable reduction in the aeromycoflora was recorded in the month of February may attributed to moderately less humidity (56%) and raised temperature to 22^{0}C-30^{0}C in the February during survey. Least concentration of airspora remained prevalent in September and October may attributed to rainy weather and less humidity. During initial period of survey, these two factors may perhaps become barrier for rapid multiplication, so propagation rate slightly declined for majority of the microfungal organisms. It seems also possibly fluctuating temperatures and relative humidity responsible to inhibit fungal growth. The majority of micro-fungal organisms require more than 75 per cent humidity for rapid multiplication and sporulation

providing nutrient rich substrates (Menghare and Bhajbhuje, 2019). 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 Japani Garden and other tree planted area of seminary hills, Nagpur provides favorable climate 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 (Yerne & Bhajbhuje, 2019).

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 (Bhajbhuje, 2013; Mishra and Deshmukh, 2009; Admas et al., 2013).

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 month of January and it was reported decline in subsequent in February may attributed to fluctuation of set of climatic condition surrounding the area understudy. 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.

Conflicts of Interest: The author declares no conflict of interest

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