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Seasonal Variation in Aeromycoflora of Satpuda Botanical Garden, Nagpur (M. S.), India

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Abstract

Airborne mycoflora disperse through the air and deposited on different surfaces and germinates causing many diseases into host on which they land. The study of aeromycoflora of particular area provides the clear view about interaction of fungal spores in the form of disease on plants. For better understanding of this phenomenon, a systematic Aeromycological survey of Satpuda Botanical Garden, Nagpur has been conducted employing Gravity plate method for late rainy season (Sept.-2018) and late winter season (Jan- 2019). During survey, altogether 3101 colonies have been recorded on nutrient agar jelly which was classified into and 39 species belonging to19 genera. A count of 2345 colonies has been recorded in the month of Jan-2019 while 756 colonies in the month of Sept. -2018. Increase in species diversity & spores concentration was reported in late winter in January-2019 (2345 colonies) against late rainy season in September-2018 (756 colonies).

Keywords: Aeromycoflora, Garden, *Cladosporium*, *Aspergillus.*

1. Introduction

Airborne fungal propagules including spores remains throughout the year in a set of climatic conditions but their existence in environment varies with change in climate (Adhikari et al., 2004). Air borne fungal propagules occur throughout almost the whole year, but the seasonal rhythm in the occurrence of air borne spores and their spectrum depends on the type of climate (Agrawal and Tiwari, 2019). The fungal densities in the air also vary in accordance with geographical regions and seasons, besides the physical parameters such as wind direction, humidity, temperature precipitation and altitude (Harishankar et al., 2016). Aeromycological survey has been conducted for a month of September-2018 and January-2019 to record the variation of extramural aeromycoflora and predominance of diverse mycobiota from the various locations of Satpuda Botanical Garden, Nagpur. The survey was carried out at an interval of 15 days during late monsoon for a month (1st-30th September 2018) and in late winter season for a month (1st -30th January 2019).

2. Materials & Methodology

Gravity plate exposure technique was employed for the isolation of extramural mycoflora of Satpuda Botanical Garden, Nagpur at an interval of 15 days for the month of September 2018 (late monsoon) and January 2019 (late winter) on nutrient agar jelly.

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 percent distribution of isolates and their incidence was recorded for each month (Menghare and Bhajbhuje, 2019).

3. Result and Discussion

Satpuda Botanical Garden Nagpur spreading over 25 hectare accommodates various plants species collected from different regions and are maintained here in very scientific manner with the help of green houses. It also encompass orchards of different tropical fruits. Students from various schools and colleges visit here for school picnics and also for scientific study of plants.

Airborne fungal spores are ubiquitous in nature and found in almost all seasons but their diversity and concentration fluctuates with respect to the environmental conditions of particular area (Verma *et al*., 2013). The existence of fungal airspora and mycotoxin secreted by them can cause various health hazards in various segments population (Kayarkar and Bhajbhuje, 2014). More than 80 genera of fungi have been recorded to cause respiratory tract allergy (Ghosh *et al*., 2014)

The variable fungal airspora, may remain in the same environment or carried to a long distance particularly by wind, depositing on healthy flora can caused many plant diseases, hence the knowledge of their periodicity is of great concern in terms of predicting the plant epidemics (Chelak and Sharma, 2012).

Comparative studies on extramural aeromycoflora of area understudy was carried out on interval of 15 days for the months of September 2018 and January 2019 at various locations of Satpuda Botanical Garden, Nagpur revealed greater number of isolates in the month of January 2019 as compared to September 2018.

Higher concentration of fungal spores during winter season indicates that environment with high humidity and low temperature is favored by fungi. During rainy season humidity was mostly high and the numbers of colonies were less due to more number of rainy days as spores were deposited onto the ground by rain drops. But in winter season no much rainfall was recorded with little variation in humidity. This probably was the reason for higher number of fungal isolates during winter season. Also certain fungi occur throughout the year indicating they can withstand seasonal variations (Pohekar *et al*., 2017).

In the month of January, the Deuteromycota dominated with 53.5% of the total colony count while it was contributing only 7.9% airspora in the month of September 2018 (Table 1 and Figure 1). The concentration of members of Ascomycota was recorded same in both the month contributing 14.2% of the total airspora (Table 1 and Figure 1). Comparative studies revealed greater number of genera and species in the month of January 2019 as compared to September 2018. Altogether 11 genera and 23 species were recorded for the month of September while 18 genera and 33 species recorded for the month of January (Table 1).

Cladosporium cladosporioides was encountered dominant contributing 22.9% airspora followed by *Cladosporium herbarum*. The other dominant isolates of airspora are *Aspergillus flavus, A. niger, Penicillium citrinum, Curvularia lunata, Rhizopus stolonifer* and *Alternaria alternate* (Figure 2).

In the month of January 2019 during second sampling, maximum numbers of fungal taxa were isolated i.e. 32 with the count of 1250 individuals while the minimum i.e. only 19 taxa with the count of

418 individuals was isolated during the first sampling of September 2018. The dominance of the fungak taxa was observed around 0.1. The Simpson 1-D index was observed to in range of 0.82 to 0.88 which indicate the high diversity of fungi. The Shannon index was reported to be 2.4 while Margalef index was observed in the range of 2.9 to 4.3 (Table 2 and Figure 3).

Table 1: Comparative distribution of Aeromycoflora of Satpuda Botanical Garden, Nagpur

S.N	Fungal organism	Number of fungal colonies				Total count	Frequency	
		September-2018		January-2019			Species	Genus
		1-15 Sept	16-30 Sept	1-15 Jan	16-30 Jan			
A.	**Zygomycota**	**0**	**6 (0.2)**	**71 (2.2)**	**105 (3.2)**	**182**	**5.8**	**5.8**
1	*Cunnighamella elegans* Lender.	-	-	11	39	50	1.6	1.6
2	*Mucor spinosus* Tiegh.	-	-	7	34	41	1.3	1.3
3	*Rhizopus stolonifer* (Eh. Ex. Rr)Lind	-	6	53	32	91	2.9	2.9
B.	**Ascomycota**	**287 (9.3)**	**152 (4.9)**	**143 (4.6)**	**298 (9.6)**	**880**	**28.4**	**28.4**
4	*Acremonium spp.*	-	-	-	13	13	0.4	0.4
5	*Aspergillus awamori Nakaz.*	-	7	-	-	7	0.2	20.3
6	*Aspergillus carbonarius* Thom	3	2	4	4	13	0.4	
7	*Aspergillus clavatus Desm.*	-	21	-	-	21	0.7	
8	*Aspergillus flavus* Link.	128	78	31	66	303	9.8	
9	*Aspergillus fumigatus* Fres.	45	3	3	3	54	1.7	
10	*Aspergillus japonicus*(Bainer) Thom	2	-	6	5	13	0.4	
11	*Aspergillus niger* van Tieghem	-	-	41	80	121	3.9	
12	*Aspergillus ochraceous Wilhelm*	-	-	2	19	21	0.7	
13	*Aspergillus sulphureus* (Fres) T&C	3	19	14	10	46	1.5	
14	*Aspergillus versicolor* (Vuillemin) Tirabochi	-	-	-	10	10	0.3	
15	*Aspergillus wentii Wehmer*	18	-	-	-	18	0.6	
16	*Neurospora sp.*	12	5	-	-	17	0.5	0.5
17	*Penicillium chrysogenum* Thom	-	-	8	11	19	0.6	7.0
18	*Penicillium citrinum* (C & S) Pitt	40	13	23	32	108	3.5	
19	*Penicillium oxalicum* Thom	7	-	11	10	28	0.9	

20	*Penicillium spp.*	-	-	-	27	27	0.9	
21	*Penicillium spp. I*	19	2	-	-	21	0.7	
22	*Penicillium spp. II*	10	2	-	-	12	0.4	
23	*Phoma glomerata* (Corda) Wr.&Hocha	-	-	-	8	8	0.3	0.3
C.	**Deuteromycota**	**90 (2.9)**	**155 (5.0)**	**843 (27.2)**	**815 (26.3)**	**1903**	**61.4**	**61.4**
24	*Alternaria alternata* Keisssler	-	-	50	41	91	2.9	2.9
25	*Cladosporium cladosporides* de Varies	20	14	374	303	711	22.9	38.1
26	*Cladosporium herbarum* (Pers) Link	-	-	229	242	471	15.2	
27	*Curvularia brachyspora* Boedjin	18	35	7	8	68	2.2	9.2
28	*Curvularia lunata* (Wakker) Boedjin	25	65	47	38	175	5.6	
29	*Curvularia prasadii* (R.L.Mathur & B.L.Mathur)	-	-	11	32	43	1.4	
30	*Fusarium moniliformae* Sheldon	-	-	14	9	23	0.7	4.5
31	*Fusarium oxysporum* Schlecht	12	25	28	-	65	2.1	
32	*Fusarium semitactum* Berk and Ravenel	13	5	17	18	53	1.7	
33	*Helminthosporium tetramera* McKinney	-	-	6	28	34	1.1	1.1
34	*Microdochium dimerum* (Penz.)Arx	-	-	11	27	38	1.2	1.2
35	*Nigrospora oryzae* (Berk. & Broome)	2	5	33	29	69	2.2	2.2
36	*Trichoderma viridae* Pers.	-	6	7	20	33	1.1	1.1
37	*Trichothecium roseum* Link	-	-	9	20	29	0.9	0.9
D.	**Other types**	**41 (1.3)**	**25 (0.8)**	**38 (1.2)**	**32 (1.1)**	**136**	**4.4**	**4.4**
38	*Sterile white mycelium*	21	14	18	21	74	2.4	2.4
39	*Sterile black mycelium*	20	11	20	11	62	2.0	2.0
	Total colonies	**418**	**338**	**1095**	**1250**	**3101**	**100**	**100**
	Percent contribution	13.5	10.9	35.3	40.3	100		

** Values in parenthesis indicate percent contribution of outdoor fungal flora over total colonies recorded.*

Table 2: Diversity indices for fungal isolates				
	1-15 Sep 2018	16-30 Sep 2018	1-15 Jan 2019	15-30 Jan 2019
Taxa_S	19	20	29	32
Individuals	418	338	1095	1250
Dominance_D	0.1346	0.1213	0.1728	0.1126
Simpson_1-D	0.8654	0.8787	0.8272	0.8874
Shannon_H	2.439	2.461	2.4	2.764
Margalef	2.982	3.263	4.001	4.347

4. Conclusion

An extramural aeromycological survey was conducted at Satpuda Botanical Garden, Nagpur revealed a wide diversity of fungal propagules in the environment of area understudy. The genera, *Aspergillus, Cladosporium, Curvularia, Penicillium* and *Alternaria* species have been reported as most common fungal taxa from the garden environment. *Cladosporium* was reported as most predominant genera followed by *Aspergilli, Penicilli, Alternaria* and *Rhizopus.* Diverse population of airborne fungal microbes was recorded in significant concentration during late winter in the month of January 2019 compared to aeromycoflora of late rainy season in the month of September 2018.

The prevalence of discrete group of viable fungal spores in the environment at different concentration is in response to various meteorological conditions including high humidity and low temperature in the Satpuda Botanical Garden. The natural outdoor environment of garden, dead grasses, leaves, fallen fruits, tree bark, dead wood, soil particles, bird droppings along with dead remains of plants and some quantity of garbage in the garden provide adequate substrate materials for propagation of a wide variety of fungi which infects many plants and may cause allergic disorders to visitors and workers at the place. Study of extramural mycoflora of Satpuda Botanical Garden is multifaceted and prodigious scope to find the significant application in human health.

Figure 1: Frequency distribution of fungal groups in the sampling site

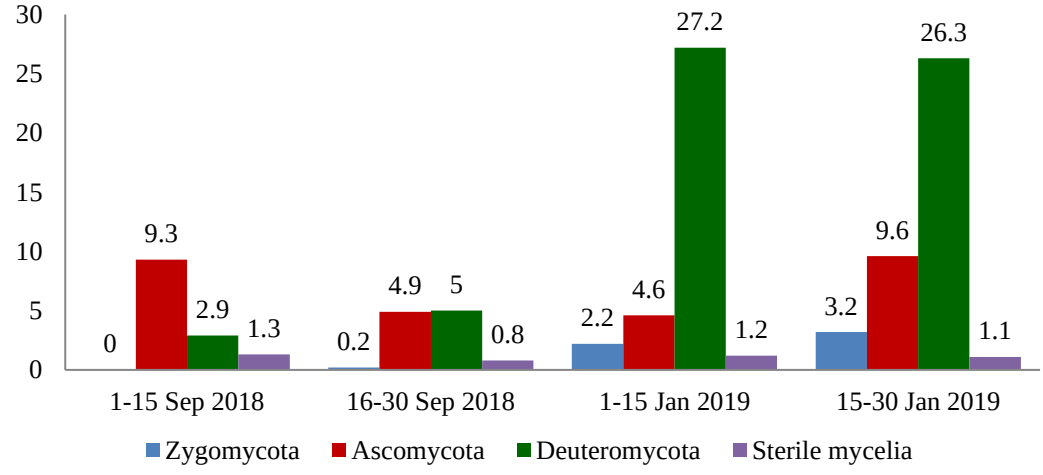
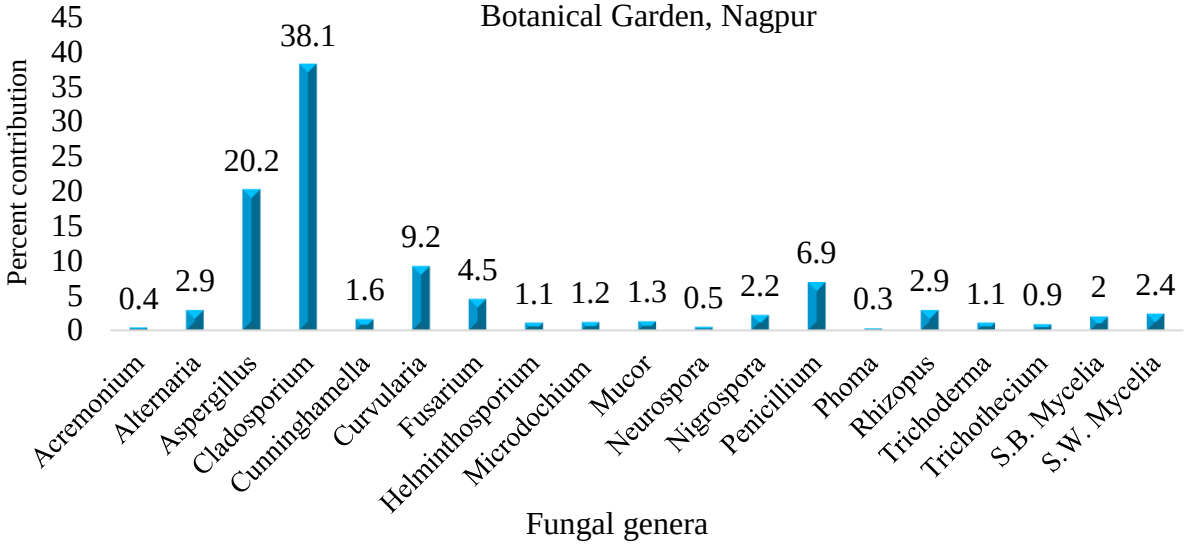


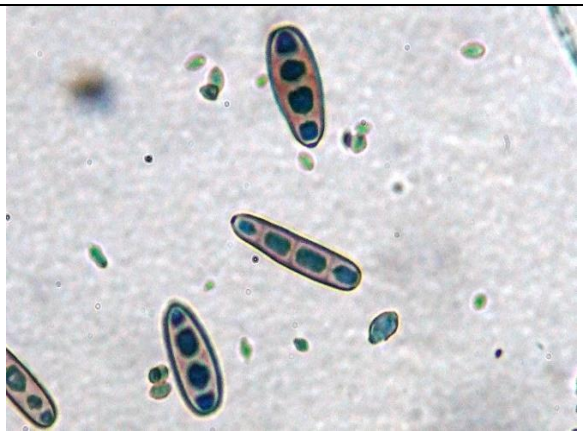
Figure 2: Genera wise percent contribution for Aeromycoflora of Satpuda Botanical Garden, Nagpur



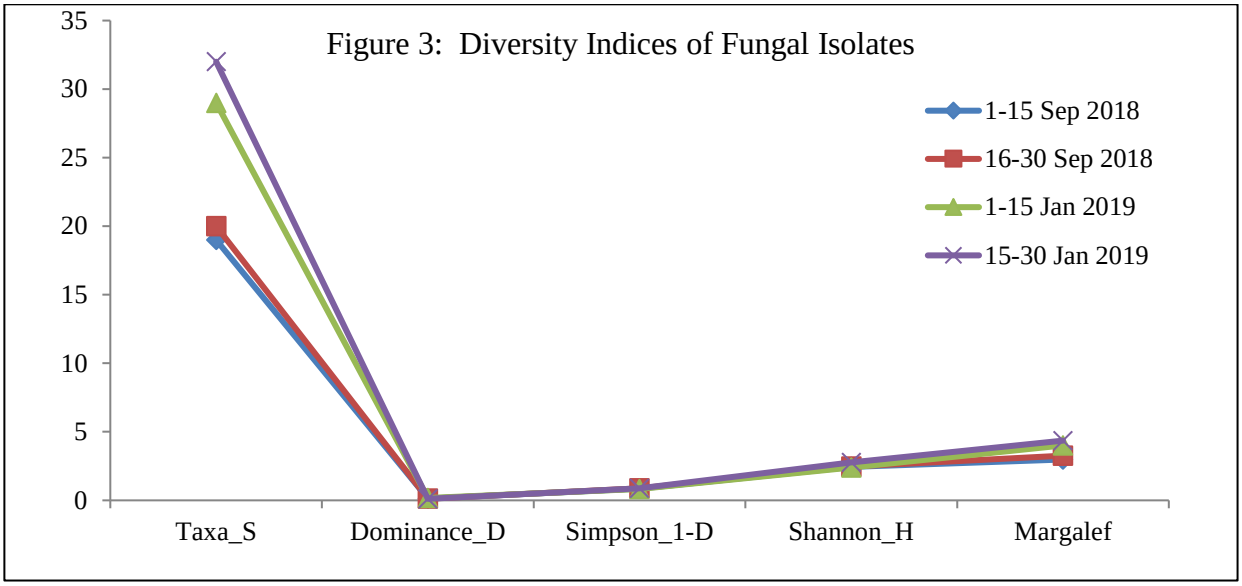
Aspergillus clavatus

Aspergillus niger

Alternaria alternata



Helminthosporium tetramera



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