

Aeromycoflora of Urban Parks of Bangalore, Karnataka, India

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ABSTRACT

The fungal spore distribution in the outdoor environments of different medium size parks like Sunrise park, Central Excise Layout park, Boulevard park and Jothivana park of urban Bengaluru, Karnataka were surveyed for one year. To isolate different spore-producing air borne fungi plate exposure method was used. A total of 130 fungal isolates were obtained from four parks of urban Bengaluru i.e. 28 from Sunrise park, 33 from Central Excise Layout park, 40 from Boulevard park and 27 from Jothivana park. Most frequently isolated fungi from Sunrise park was *Aspergillus* sp., Central Excise Layout park was *Verticillium lecanii*, Boulevard park was *Epicoccum* sp., *Trichoderma harzianum*, *Verticillium* sp. and from Jothivana park was *Epicoccum* sp. Most of these air borne fungi were harmful to plants, animals and humans residing in parks. The different air-borne fungal genera like *Aspergillus*, *Fusarium*, *Cladosporium*, *Alternaria*, *Rhizopus* and *Nigrospora* cause various allergies and respiratory problems in the person's regularly visiting the parks of study area. For the first time aeromycoflora of parks were reported from Karnataka and second time from India.

Key words: Aeromycoflora, Bengaluru, parks, lungs of the city

INTRODUCTION

The term aerobiology was given by a pathologist Fred Campbell Meir; which constitutes differentiate air-borne microbes such as fungal spores, pollen grains and many other forms of microbes. Aeromycoflora was the study of air-borne fungal spores present in the atmosphere. More than 80,000 fungal species were observed in the largest bioaerosol on earth (Jaiswal and Prasad, 2021). In the urban national highways of Vijayawada, Andhra Pradesh, the most frequently isolated fungal species are *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus fumigates*, *Aspergillus awamorii*, *Alternaria alternate*, *Chaetomium globosum*, *Pencillium* sp., *Rhizopus stolanifer* (Nagadesi and Jayraj, 2016) and from the urban markets of Bangalore *Alternaria alternate*, *Aspergillus niger*, *Rhizopus stolanifer* (Nagadesi et al., 2020). Today more than 30% of the world population was known to suffer from one or other allergic ailments such as bronchial asthma, allergic rhinitis and atopic dermatitis. Major causative agents are fungal spores, pollen grains, dust mites, insect debris, etc. (Singh, 2017). Aeromycoflora is in some ways harmful to the city environment such as spoilage of food products, damages lumber wood, paper, cloth

materials, and also causes many allergies to mankind. It also produces toxins when they grow on food products and which lead to food poisoning (Jaiswal and Prasad, 2021). So, the aeromycoflora data of different metro cities, states and countries were required. The metro city like Bengaluru has 1,247 developed parks in different places of urban and rural areas. The largest park in Bengaluru city was Lalbagh botanical garden along with other major parks like Bannerghatta Biological park JP park, Lumbini Gardens, MN Krishna Rao park, Wonderla Amusement park, and Freedom park. The smallest park in Bangalore was Bugle rock park. There were around 40 public parks in Bangalore. The present research was made to determine the aeromycoflora present in the parks of urban Bangalore, Karnataka, India.

MATERIALS AND METHODS

The parks are the less polluted areas having a large number of greeneries. The average temperature of this place was recorded as 61 to 93°F, the average rainfall was 970 mm and the average humidity was recorded as 69%. There was a vivid variety of air-borne species in the outdoor environment of parks. Sunrise park, Central Excise Layout park, Jothivana

park and Boulevard park were visited to take samples of aeromycoflora. The geographical location of the Sunrise park was 13°02'39.2"N 77°34'42.0"E, Central excise layout park was 13°02'22.1"N 77°34'48.7"E, Boulevard park was 13°02'23.3"N 77°34'06.5"E and Jothivana park was 13°02'02.4"N 77°34'31.9"E.

Sampling of air borne fungal spores was done by plate exposure method containing Potato Dextrose Agar (PDA) medium. The Petri plates were taken to four different parks, namely, Sunrise park, Central Excise Layout park, Jothivana park and Boulevard park. The samples of Sunrise at two points and Excise layout at three points were taken from October to November 2022 in busy hours 5:30 to 6:30 a.m. Jothivana park at two points and Boulevard at three points from October to November 2022 in busy hours 7:30 to 9:30 a.m. Petri dishes with medium were exposed against air current for 10 min and brought to the laboratory. The petriplates containing the samples were incubated for 3 to 7 days in incubator. After completing incubation the isolated fungal colonies data were collected and the percentage frequency and percentage contribution of the total fungal flora were assessed as:

% frequency = (Number of observations in which a species appeared/total number of observations) × 100

% contribution = (Total number of colonies of species in all observations taken together/ Total number of colonies in all the species) × 100

The colonial features and morphological features of the fungal colonies were studied using compound microscope. The slides of

fungi were carried out by mounting with lactophenol and cotton blue stain and covered with cover slip. The fungal colonies were identified on the basis of micro and macro morphology; and reverse and surface colouration of fungi grown on the PDA media. The fungi were identified up to genus level and in some cases up to species level.

RESULTS AND DISCUSSION

In the parks of urban Bengaluru, the aeromycoflora study revealed that there was a huge variety of fungal spores present in the air. Thus, they were cosmopolitan. Air-borne fungal spores invaded outdoor environment of study area. A total of 130 fungal spore type was isolated from four different parks of urban Bengaluru, in which 13 genera, 17 species were identified. Overall highest prevalence of fungal types was represented by *Aspergillus* (6 spp.) followed by *Alternaria* and *Curvularia* (4 spp. each), respectively. Most frequently isolated fungi was *Epicoccum* sp followed by *Fusarium roseum*, *Verticillium lecanii*, *Aspergillus* sp. There were also *Trichoderma* sp., *Cladosporium cladosporioides*, *Colletotrichum gloeosporioides* and *Rhizopus oryzae* grown less in number when compared to other species (Tables 1, 2, 3 and 4). Most frequently isolated fungi from Sunrise park was *Aspergillus* sp and the least isolated was *C. gloeosporioides*, *F. roseum*, *Lasiiodiplodia theobromae* (Table 1). From Central Excise Layout park *Verticillium lecanii* was most and least isolated were *A. flavus*, *Chaetomium gloeosporioides* and *F. oxysporum* (Table 2). From Boulevard park *Epicoccum* sp, *Verticillium* sp., and *T. harzianum* were more

Table 1. Aeromycoflora found in Sunrise park

S. No.	Area	Colour of colony	Fungal species	No of isolates	% of frequency	% of contribution
1.	Sunrise park point 1	Green	<i>Acremonium strictum</i>	2	2	7.14
2.	Sunrise park point 1	Yellow	<i>Colletotrichum gloeosporioides</i>	1	1	3.57
3.	Sunrise park point 1	Red	<i>Epicoccum purpurascens</i>	2	2	7.14
4.	Sunrise park point 1	Orange	<i>Fusarium oxysporum</i>	2	2	7.14
5.	Sunrise park point 1	Green	<i>Trichoderma harzianum</i>	3	3	10.71
6.	Sunrise park point 1	Blackish white	<i>Aspergillus</i> sp.	4	4	14.28
7.	Sunrise park point 2	Brownish white	<i>Epicoccum nigrum</i>	2	2	7.14
8.	Sunrise park point 2	Red	<i>Fusarium roseum</i>	1	1	3.57
9.	Sunrise park point 2	White and black	<i>Rhizopus stolonifer</i>	2	2	7.14
10.	Sunrise park point 2	White	<i>Verticillium dahliae</i>	2	2	7.14
11.	Sunrise park point 2	Black	<i>Chaetomium globosum</i>	3	3	10.71
12.	Sunrise park point 2	Blackish white	<i>Lasiiodiplodia theobromae</i>	1	1	3.57
13.	Sunrise park point 2	Black	<i>Aspergillus niger</i>	2	2	7.14
14.	Sunrise park point 2	White	<i>Sterile</i>	1	1	3.57

Table 2. Aeromycoflora found in Central excise park

S. No.	Area	Colour of colony	Fungal species	No of isolates	% of frequency	% of contribution
1.	Central excise park point 1	White	<i>Verticillium lecanii</i>	4	4	12.12
2.	Central excise park point 1	Brownish white	<i>Absida corymbifera</i>	2	2	6.06
3.	Central excise park point 1	Brownish white	<i>Acremonium strictum</i>	3	3	9.09
4.	Central excise park point 1	Milky white	<i>Colletrotrichum gloeosporioides</i>	1	1	3.03
5.	Central excise park point 1	Greyish white	<i>Chaetomium globosum</i>	1	1	3.03
6.	Central excise park points 2	Greyish black	<i>Rhizopus oryzae</i>	2	2	6.06
7.	Central excise park points 2	Brown	<i>Verticillium dahliae</i>	3	3	9.09
8.	Central excise park points 2	Orange	<i>Fusarium oxysporum</i>	1	1	3.03
9.	Central excise park points 2	Yellow	<i>Aspergillus flavus</i>	1	1	3.03
10.	Central excise park points 2	Black	sterile	4	4	12.12
11.	Central excise park points 3	Yellowish white	<i>Epicoccum nigrum</i>	2	2	6.06
12.	Central excise park points 3	Brown	<i>Torula herbarum</i>	3	3	9.09
13.	Central excise park points 3	Green	<i>Trichoderma harzianum</i>	2	2	6.06
14.	Central excise park points 3	White	<i>Verticillium sp</i>	4	4	12.12

and least isolated were *Epicoccum* sp., *E. purpurascens* and *V. lecanii* (Table 3). From Jothivana park *Epicoccum* sp. was more and least isolated were *A. niger* and *F. oxysporum* (Table 4).

Neighbourhood parks are maintained by the municipality of Bengaluru and were mainly

designed for recreation purposes, completely neglecting the fact that these spaces could be essential for biodiversity (Swamy *et al.*, 2019). Urban parks are essential to the resilience of urban space structures and there was prerequisite to build an integration between the ecological, social, economic, aesthetic

Table 3. Aeromycoflora found in Boulevard park

S. No.	Area	Colour of colony	Fungal species	No of isolates	% of frequency	% of contribution
1.	Boulevard park point 1	White	<i>Verticillium dahliae</i>	2	2	5.0
2.	Boulevard park point 1	Black	<i>Cladosporium herbarum</i>	2	2	5.0
3.	Boulevard park point 1	Brown	<i>Epicoccum</i> sp.	3	3	7.5
4.	Boulevard park point 1	Red	<i>Epicoccum purpurascens</i>	1	1	2.5
5.	Boulevard park point 1	Green	<i>Trichoderma harzianum</i>	4	4	10.0
6.	Boulevard park point 1	White	<i>Fusarium roseum</i>	3	3	7.5
7.	Boulevard park point 1	Red and green	<i>Epicoccum</i> sp.	1	1	2.5
8.	Boulevard park point 2	Green	<i>Trichoderma</i> sp.	3	3	7.5
9.	Boulevard park point 2	Green and white	<i>Trichoderma viride</i>	2	2	5.0
10.	Boulevard park point 2	White	<i>Fusarium oxysporum</i>	3	3	7.5
11.	Boulevard park point 2	White	<i>Verticillium</i> sp.	4	4	10.0
12.	Boulevard park point 3	Black	<i>Nigrospora oryzae</i>	3	3	7.5
13.	Boulevard park point 3	Blackish white	<i>Epicoccum nigrum</i>	2	2	5.0
14.	Boulevard park point 3	Blackish grey	<i>Epicoccum</i> sp.	4	4	10.0
15.	Boulevard park point 3	Whitish black	<i>Colletrotrichum gloeosporioides</i>	2	2	5.0
16.	Boulevard park point 3	White	<i>Verticillium lecanii</i>	1	1	2.5

Table 4. Aeromycoflora found in Jothivana park

S. No.	Area	Colour of colony	Fungal species	No of isolates	% of frequency	% of contribution
1.	Jothivana park 1	Brown	<i>Epicoccum nigrum</i>	2	2	7.4
2.	Jothivana park 1	Brown and white	<i>Epicoccum</i> sp.	3	3	11.1
3.	Jothivana park 1	Black	<i>Chaetomium globosum</i>	2	2	7.4
4.	Jothivana park 1	Redish white	<i>Fusarium oxysporum</i>	1	1	3.7
5.	Jothivana park 1	White	<i>Fusarium roseum</i>	3	3	11.1
6.	Jothivana park 1	Black	<i>Cladosporium herbarum</i>	2	2	7.4
7.	Jothivana park 1	Brown and white	<i>Colletrotrichum gloeosporioides</i>	3	3	11.1
8.	Jothivana park 2	Redish white	<i>Verticillium lecanii</i>	3	3	11.1
9.	Jothivana park 2	Brown and white	<i>Epicoccum</i> sp.	3	3	11.1
10.	Jothivana park 2	Brown and white	<i>Verticillium dahliae</i>	2	2	7.4
11.	Jothivana park 2	Green	<i>Cladosporium cladosporioides</i>	2	2	7.4
12.	Jothivana park 2	Transparent and black	<i>Aspergillus niger</i>	1	1	3.7

aspects of urban landscape architecture (Malini Shetty, 2023). In the present study, different urban parks like Sunrise park, Central Excise Layout park, Jothivana park and Boulevard park aeromycoflora were studied. Fungal spores constituted a very significant factor of bio-aerosol and they were often much more numerous than other air-borne bio-particulate matters.

All the fungal species found were very common in India as well as in Bangalore. The fungal spore's distribution in the outdoor environment of urban roads of Bengaluru, India was also studied by Rajan and Nagadesi (2021). A total of 230 fungal colonies were isolated from four urban roads atmosphere. The spores of *A. flavus* and *F. moniliformae* were frequently isolated forms, whereas the least isolated spores were *Nigrospora* and *Trichoderma* (Rajan and Nagadesi, 2021). In the present study, a total of 130 fungal colonies were isolated from four parks of Hebbal, Urban Bengaluru, Karnataka. According to literature survey on aeromycoflora, related diseases and allergens. The presence of *Aspergillus* sp., *Fusarium* sp., *Cladosporium* sp., *Alternaria* sp., *Rhizopus* sp., *Penicillium* sp., *Curvularia* sp. and *Nigrospora* sp. caused various diseases like allergic rhinitis, allergic sinusitis, asthma, atopic dermatitis urticaria (Deshmukh and Ingole, 2018).

In the air of the urban parks of Poland, the most dominant spores are strong allergenic or considered as potentially allergenic. So, *Cladosporium* spores were found in enormous concentrations in all urban parks studied in Poland (Kasprzyk *et al.*, 2021). In the present study different air-borne fungal genera like *Aspergillus*, *Fusarium*, *Cladosporium*, *Alternaria*, *Rhizopus* and *Nigrospora* caused various diseases like allergic sinusitis, asthma and respiratory problems in the person's regularly visiting to the parks of Hebbal, Karnataka, India.

CONCLUSION

One hundred and thirty fungal spores were isolated from four different parks of Urban Bengaluru. A total of 13 genera of fungi having 17 species were seen in which, highest prevalence of fungal types was represented by *Epicoecum*. It was also noticed that most of the fungal spore which was isolated caused various diseases and allergens. These fungal spores are very harmful to the people who visit the

parks frequently and also these can affect the childrens who come to play in the park. Fungi usually take shelter in warm and damp environments hence, they are more in summer season. So, it is better to keep yourself clean and dry. After every visit to park make sure that you clean yourself thoroughly to get rid of fungal spores present in the environment.

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