

# Incidence of Airborne Fungal Spores at Raipur with Special Reference to Railway Station

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**Abstract:** *Aeromycoflora* of Railway station was studied with the help of petriplate method in the year July 2007 to June 2008. During investigation period total 67 fungal species belongs to 39 genera were observed. Environmental factor play an important role for the distribution of fungal spores. Out of total maximum number of fungi were isolated from Anamorphic group moderate for Ascomycotina, Zygomycotina and minimum for Basidiomycotina and Mycelia sterila. Maximum frequency of aeromycoflora shown by *Aspergillus niger* and maximum percentage contribution shown by *Cladosporium oxysporium*.

**Keywords:** Railway station, incidence, fungal spores, *Aeromycoflora*, Percentage frequency

## 1. Introduction

Life on earth is possible only due to the cover of air surrounding the planet. Air has its benefits as it provide necessary oxygen for the survival of live on earth. Aerobiology is a branch of biology that studies organic particles, such as bacteria, fungal spores, very small insects, pollen which are passively transported by the air (Spieksma, 1991) [1]. Aerobiology is concerned with the activities in the global atmosphere. This multidisciplinary science also deals with bio particles found in environments. Air is a carrier of microorganisms which are present in our environment. The aerobiological monitoring of mold spores is of great importance because of their possible effects on the population's health, as they are responsible for different diseases particularly those affecting respiratory system. The ultimate goal of aerobiology is to understand the floor of biota in the atmosphere in order to help ensure human health and well-being through managing the many diverse population and environments on earth. This involves increasing our scientific understanding of aerobiological process to the point where we can accurately and precisely for cast the movement of important aerobiota. One of the important aspects of aerobiology is that it provides accurate information regarding the quality of air of an area. Like many places railway station is such place which has large amount of activity round the clock. Such hectic activity in an

area makes the place vulnerable for large amount of microorganisms to move around in air due to human and other activities. Therefore to avoid any medical calamity in a railway station aerobiological study of such place is must. Major problem causing organism in any outdoor or indoor place is basically fungi therefore fungal aerobiological study of railway station should be first concern.

## 2. Materials and Methods

In the present study for analysis of the *Aeromycoflora*, railway station of Raipur were selected in the year July 2007 to June 2008. For survey of *Aeromycoflora*, ten sterilized Petriplates containing PDA media were exposed 5 to 10 min. at Railway station of Raipur. These exposed Petri plates brought in to the laboratory and incubated at  $26 \pm 1^{\circ}\text{C}$ . At the end of incubation period fungal colonies are counted, isolated and identified with the help of available literatures and finally identified by the authentic authority. For ecological studies at the end of the incubation period of *Aeromycoflora*, during the survey period percentage frequency and percentage contribution of fungal flora is calculated (Jadhav and Tiwari, 1994) [2] with the help of the following formula:

$$\text{Percentage frequency} = \frac{\text{Number of observation in which a species appeared}}{\text{Total number of observations}} \times 100$$

$$\text{Percentage contribution} = \frac{\text{Total number of colonies of a species in all observations taken together}}{\text{Total number of colonies of all species}} \times 100$$

## 3. Result and Discussion

### 3.1 Seasonal variation

Seasonal variation is a component of a time series which is defined as the repetitive and predictable movement around the trend line in one year or less. It is detected by measuring the quantity of interest for small time intervals, such as days, weeks, months or quarters. Seasonal variation play important role in distribution of fungal species of a

particular area. Fungal species affected by weather conditions like temperature, relative humidity and rainfall. Weather of Raipur city is characterized by three seasons *i.e.* rainy season, winter season and summer season. During investigation period 67 fungal species (1605 fungal colonies) belongs to 39 genera were observed. Out of them, 05 fungal species (42 fungal colonies) belongs to 05 genera from Zygomycotina, 02 fungal species (06 colonies) belongs to 02 genera from Basidiomycotina, 07 fungal species (101 fungal colonies) belongs to 07 fungal genera from Ascomycotina, 51 fungal species (1384 fungal colonies)

belongs to 24 genera from Anamorphic fungi and 02 fungal species (72 fungal colonies) belongs to 01 genus from *Mycelia sterilia* were recorded (**Table-1**).

During this investigation period maximum fungal species 56 species were recorded during winter season due to favorable temperature (21.67<sup>0</sup>C) and humidity (56.93%) and moderate 38 fungal species recorded in rainy season due to temperature (26.97<sup>0</sup>C) and humidity (78.84%) and minimum fungal species 27 species observed in summer season due to unfavorable temperature (37.78<sup>0</sup>C) and humidity (44.69%). (**Fig.1**). These results are in agreement with Jadhav (1996), Sharma (2001). Kunjam (2007) [3] also reported maximum of 65 fungal species during winter season moderate of 52 in rainy season and minimum of 38 in summer season out of total 71 fungal species. Das and Bhattacharya (2007) [4] also reported maximum fungal species during winter season while minimum fungal species recorded in summer season. Lall (2008) [5] also observed maximum fungi in winter, moderate in rainy season while minimum in summer season.

### Mycobial ecology

Mycobial ecology is the study of interrelationships between microorganisms and their living and nonliving environments. In the present study percentage frequency and percentage contribution of Aeromycoflora observed during July 2007 to June 2008. It was also observed that maximum frequency of the aeromycoflora shown by *Aspergillus flavus*, *A. niger* (100.00%), *Mycelia sterilia* white (83.33%), *Penicillium oxalicum* (75.00%), *Aspergillus fumigatus* (66.66%), *Altenaria alternata*, *Aspergillus parasiticus*, *Fusarium pallidoroseum* (58.33%), while minimum frequency shown by *Cunninghamella echinulata* (8.33%), *Alysidium resinae* (8.33%), *Phialophora fastigata* (8.33%), *Ascotricha chartarum* (8.33%), *Eupenicillium sheartii* (8.33%), *Myrothecium verrucaria* (8.33%), *Acremonium fusidioides*, *A. roseum*, *Aspergillus clavatus*, *A. stellatus*, *A. tamarii*, *Basidiospora alba*, *Curvularia lunata* var. *aeria*, *Fusarium moniliformae*, *Helminthosporium* sp., *Penicillium italicum*, *P. sclerotiorum*, *Pithomyces chartarum*, *Stachybotris elegans*, *Trichoderma viridae*, *Trichothecium roseum* and *Trichuris spiralis* (8.33%) (**Table-1**). These results agreement with Jadhav and Tiwari (1994). Tavora *et al.* (2003), Green *et al.* (2006), Singh (2006), Kunjam (2007), Ozkara *et al.* (2007), Lall (2008) [7] also reported that *Aspergillus niger* was most frequent fungi.

**Table 1:** Showing fungal distribution of Aeromycoflora during July 2007 - June 2008

S. N.	Name of the Fungal Species	Rainy season					Winter season					Summer season					Grand Total No. of Fungal Colonies	Percentage frequency	Percentage contribution
		July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total			
A	ZYGOMYCOTINA																		
1	<i>Choanephora cucurbitarum</i>	-	1	4	1	6	-	-	-	-	-	-	-	-	-	-	6	25	0.37
2	<i>Cunninghamella echinulata</i>	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	3	8.33	0.18
3	<i>Mucor racemosus</i>	1	-	2	-	3	-	-	1	-	1	-	-	1	-	1	5	33.3	0.31
4	<i>Rhizopus stolonifer</i>	1	1	1	-	3	1	-	-	9	10	4	-	-	5	9	22	50	1.37
5	<i>Syncephalastrum racemosum</i>	-	1	-	-	1	4	-	1	-	5	-	-	-	-	-	6	25	0.37
	Total Number of Fungal Colonies	2	3	7	1	13	8	-	2	9	19	4	-	1	5	10	42	-	2.61
	Total Number of Fungal Species	2	3	3	1	4	3	-	2	1	4	1	-	1	1	2	5	-	7.46
	Total Number of Fungal Genera	2	3	3	1	4	3	-	2	1	4	1	-	1	1	2	5	-	12.8
B	BASIDIOMYCOTINA																		
6	<i>Alysidium resinae</i>	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	3	8.33	0.18
7	<i>Phialophora fastigata</i>	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	3	8.33	0.18
	Total Number of Fungal Colonies	-	-	-	3	3	3	-	-	-	3	-	-	-	-	-	6	-	0.37
	Total Number of Fungal Species	-	-	-	1	1	1	-	-	-	1	-	-	-	-	-	2	-	2.98
	Total Number of Fungal Genera	-	-	-	1	1	1	-	-	-	1	-	-	-	-	-	2	-	5.12
C	ASCOMYCOTINA																		
8	<i>Ascotricha chartarum</i>	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	8.33	0.06

Showing fungal distribution of Aeromycoflora during July 2007 - June 2008

S. N.	Name of the Fungal Species	Rainy season					Winter season					Summer season					Grand Total No. of Fungal Colonies	Percentage frequency	Percentage contribution
		July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total			
9	<i>Byssochalamus niveus</i>	-	-	-	-	-	-	-	2	-	2	-	-	2	4	6	8	25	0.49
10	<i>Chaetomium globosum</i>	-	-	-	-	-	5	3	-	-	8	-	-	-	-	-	8	16.7	0.49
11	<i>Eupenicillium sheartii</i>	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	2	8.33	0.12
12	<i>Khuskia oryzae</i>	-	-	-	7	7	13	24	24	7	68	-	-	-	-	-	75	41.7	4.67
13	<i>Myrothecium verrucaria</i>	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	8.33	0.06
14	<i>Thielavia terricola</i>	4	1	1	-	6	-	-	-	-	-	-	-	-	-	-	6	25	0.37
	Total Number of Fungal Colonies	4	1	2	7	14	18	30	26	7	81	-	-	2	4	6	101	-	6.29
	Total Number of Fungal Species	1	1	2	1	3	2	4	2	1	5	-	-	1	1	1	7	-	10.4
	Total Number of Fungal Genera	1	1	2	1	3	2	4	2	1	5	-	-	1	1	1	7	-	17.9
D ANAMORPHIC FUNGI																			
15	<i>Acremonium fusidioides</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	8.33	0.06
16	<i>A. kilience</i>	2	1	-	-	3	-	1	-	-	1	-	-	-	-	-	4	25	0.24
17	<i>A. roseum</i>	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	2	8.33	0.12
18	<i>Altenaria alternata</i>	1	-	1	8	10	4	-	-	12	16	7	5	-	-	12	38	58.3	2.36
19	<i>A. citri</i>	-	-	-	2	2	-	-	9	6	15	8	-	-	3	11	28	41.7	1.74
20	<i>A. raphani</i>	-	-	-	-	-	-	3	8	9	20	7	3	-	-	10	30	41.7	1.86
21	<i>Aspergillus carneus</i>	1	-	-	1	2	-	-	-	1	1	-	-	-	-	-	3	25	0.18
22	<i>A. clavatus</i>	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	8.33	0.06
23	<i>A. flavus</i>	2	1	5	7	15	11	1	5	4	21	17	8	8	11	44	80	100	4.98
24	<i>A. fumigatus</i>	-	1	1	7	9	-	2	-	1	3	2	2	-	-	4	16	66.7	0.99
25	<i>A. nidulans</i>	1	-	-	1	2	-	-	-	1	1	-	1	19	8	28	31	50	1.93

Showing fungal distribution of Aeromycoflora during July 2007 - June 2008

S. N.	Name of the Fungal Species	Rainy season					Winter season					Summer season					Grand Total No. of Fungal Colonies	Percentage frequency	Percentage contribution
		July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total			
26	<i>A. niger</i>	4	6	13	21	44	18	9	10	8	45	30	19	44	22	115	204	100	12.7
27	<i>A. ochraceus</i>	-	-	1	-	1	-	-	-	11	11	-	-	-	-	-	12	16.7	0.74
28	<i>A. parasiticus</i>	1	5	-	4	10	-	1	2	1	4	1	-	-	-	1	15	58.3	0.93
29	<i>A. stellatus</i>	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	8.33	0.06
30	<i>A. tamaritii</i>	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	5	8.33	0.31
31	<i>A. terreus</i>	-	-	-	2	2	1	-	-	-	1	4	-	13	6	23	26	41.7	1.61
32	<i>A. versicolor</i>	3	6	3	3	15	-	-	-	7	7	2	-	-	-	2	24	50	1.4
33	<i>Basidiospora alba</i>	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	2	8.33	0.12
34	<i>Botryoidiplodia theobromae</i>	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	2	16.7	0.12
35	<i>Cladosporium cladosporiodes</i>	13	-	-	3	16	-	-	2	45	47	-	-	-	-	-	63	33.3	3.9
36	<i>C. oxysporium</i>	-	-	-	-	-	147	111	98	64	420	14	-	-	-	14	434	41.7	27
37	<i>C. sphaerospermum</i>	-	-	-	-	-	-	3	10	37	50	-	-	-	-	-	50	25	3.11

38	<i>Curvularia lunata</i> var. <i>aeria</i>	-	-	-	4	4	-	-	-	-	-	-	-	-	-	4	8.33	0.24	
39	<i>C. pallescense</i>	-	-	-	-	-	3	5	-	8	-	-	-	-	-	8	16.7	0.49	
40	<i>Diplococcium</i> sp.	-	-	-	6	6	4	-	1	5	10	3	-	-	-	3	19	41.7	1.18
41	<i>Drechslera rostrata</i>	-	-	1	1	2	-	-	-	-	-	-	-	-	-	2	16.7	0.12	
42	<i>D. specifer</i>	1	2	-	-	3	-	3	-	-	3	-	-	-	6	6	12	33.3	0.74
43	<i>Fusarium chlamydosporum</i>	-	-	-	2	2	-	-	2	-	2	3	-	-	-	3	7	25	0.43
44	<i>F. moniliformae</i>	-	-	-	-	-	6	-	-	-	6	-	-	-	-	-	6	8.33	0.37
45	<i>F. pallidoroseum</i>	-	-	-	7	7	2	3	5	4	14	4	3	-	-	7	28	58.3	1.74
46	<i>Gilmaniella humicola</i>	-	-	-	-	-	-	2	3	2	7	-	-	-	-	-	7	25	0.43

Showing fungal distribution of Aeromycoflora during July 2007 - June 2008

S. N.	Name of the Fungal Species	Rainy season					Winter season					Summer season					Grand total	Percentage frequency	Percentage contribution
		July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total			
47	<i>Helminthosporium</i> sp.	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	8.33	0.06
48	<i>Monilia</i> sp.	-	-	-	-	-	-	-	-	-	-	4	-	-	16	20	20	16.7	1.24
49	<i>Paecilomyces variotii</i>	1	-	-	2	3	-	2	-	-	2	-	-	-	-	-	5	25	0.31
50	<i>Penicillium chrysogenum</i>	1	-	-	-	1	7	-	4	24	35	12	8	-	-	20	56	50	3.48
51	<i>P. citrinum</i>	1	-	-	-	1	-	-	2	3	5	-	-	-	-	-	6	25	0.37
52	<i>P. italicum</i>	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	8.33	0.06
53	<i>P. oxalicum</i>	5	5	2	13	25	-	1	2	8	11	9	12	-	-	21	57	75	3.55
54	<i>P. sclerotiorum</i>	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	8.33	0.06
55	<i>Pestalotiopsis glandicola</i>	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	4	16.7	0.24
56	<i>Phoma exigua</i>	-	-	-	-	-	-	2	3	-	5	-	-	-	2	2	7	25	0.43
57	<i>P. herbarum</i>	-	-	-	17	17	11	-	1	1	13	-	-	1	2	3	33	41.7	2.05
58	<i>P. leveillei</i>	-	-	-	1	1	-	-	2	-	2	1	-	-	-	1	4	25	0.24
59	<i>Pithomyces chartarum</i>	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	8.33	0.06
60	<i>Stachybotrys elegans</i>	-	-	-	-	-	-	4	-	-	4	-	-	-	-	-	4	8.33	0.24
61	<i>Spilodochium veroniae</i>	-	-	-	-	-	-	-	2	2	4	-	-	-	-	-	4	16.7	0.24
62	<i>Stemphillium</i> sp.	-	-	-	-	-	4	7	-	-	11	-	-	-	-	-	11	16.7	0.68
63	<i>Trichoderma viridae</i>	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	2	8.33	0.12
64	<i>Trichothecium roseum</i>	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	8.33	0.06
65	<i>Trichurus spiralis</i>	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	8.33	0.06
	Total Number of Fungal Colonies	37	27	29	114	207	223	168	179	256	826	129	61	85	76	351	1384	-	86.2
	Total Number of Fungal Species	14	8	10	22	28	15	22	23	22	44	18	9	5	10	22	51	-	76.1
	Total Number of Fungal Genera	7	4	6	11	14	9	16	12	9	20	9	4	2	6	10	24	-	61.5

Showing fungal distribution of Aeromycoflora during July 2007 - June 2008

S. N.	Name of the Fungal Species	Rainy season					Winter season					Summer season					Grand Total	Percentage frequency	Percentage contribution
		July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total	No. of Fungal Colonies		

	July	Aug.	Sep.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total	Mar.	April	May	June	Total				
E MYCELIA STERILA																			
66 Mycelia sterila (white)	18	4	5	-	27	3	4	4	5	16	3	4	-	10	17	60	83.3	3.73	
67 Mycelia sterila (black)	-	1	2	3	6	2	-	1	-	3	3	-	-	-	3	12	50	0.74	
Total Number of Fungal Colonies	18	5	7	3	33	5	4	5	5	19	6	4	-	10	20	72	-	4.48	
Total Number of Fungal Species	1	2	2	1	2	2	1	2	1	2	2	1	-	1	2	2	-	2.98	
Total Number of Fungal Genera	1	1	1	1	1	1	1	1	1	1	1	1	-	1	1	1	-	2.56	
Grand Total Number of Fungal Colonies	61	36	45	128	270	257	202	212	277	948	139	65	88	95	387	1605	-	-	
Grand Total Number of Fungal Species	18	14	17	26	38	23	27	29	25	56	21	10	7	13	27	67	-	-	
Grand Total Number of Fungal Genera	11	9	12	15	23	16	21	17	12	31	11	5	4	9	14	39	-	-	

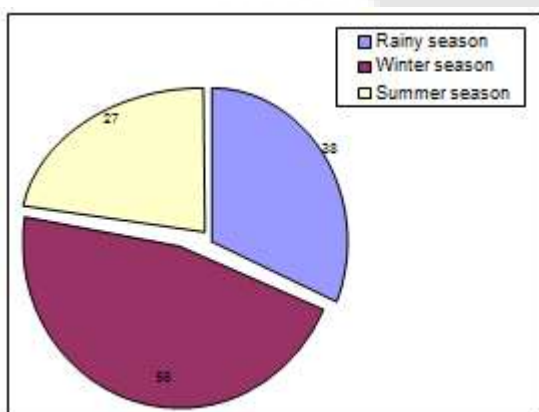


Figure 1: Showing season wise fungal species distribution of Aeromycoflora during July 2007 to June 2008

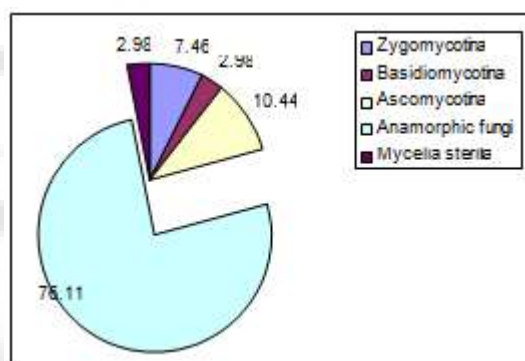


Figure 2: Showing groupwise percentage contribution of fungal species of Aeromycoflora during July 2007 to June 2008

Out of total Aeromycoflora percentage contribution of each fungal group were recorded i.e. Zygomycotina (7.46%), Basidiomycotina (2.98%), Ascomycotina (10.44%), Anamorphic fungi (76.11%) and Mycelia sterilia (2.98%) (Table-2). It was also observed that Anamorphic fungi have maximum contribution of the total fungal flora. (Fig-2). This study is in agreement with Jadhav (1996) and Kunjam (2007).

Table 2: Showing groupwise percentage contribution of fungal species of Aeromycoflora during July 2007 to June 2008

S.N.	Name of fungal groups	Percentage contribution
1.	Zygomycotina	7.46
2.	Basidiomycotina	2.98
3.	Ascomycotina	10.44
4.	Anamorphic fungi	76.11
5.	Mycelia sterilia	2.98

The member of Anamorphic fungi being the most dominant contributed throughout the seasons. Similar result found Singh (2006), Saluja (2005), Lall (2008), Jadhav and Kunjam (2009) on aeromycoflora of a tribal area of Chhattisgarh.

It is also observed that maximum percentage contribution were recorded that *Cladosporium oxysporium* (27.00%) followed by *Aspergillus niger* (12.70%), *A. flavus* (4.98%) and *Khushkia oryzae* (4.67%), similarly the minimum percentage contribution (0.06%) recorded for *Ascotricha chartarum*, *Myrothecium verrucaria*, *Acremonium fusidioides*, *Aspergillus clavatus*, *Helminthosporium sp.*, *Penicillium italicum*, *P. sclerotiorum*, *Pithomyces chartarum*, *Trichothecium roseum* and *Trichurus spiralis* (Table-1) similar results observed. This results agreement with Sabariego *et al.* (2007), Aira *et al.* (2007), Ozkara *et al.* (2007) also observed *Cladosporium* spores probably occur more abundantly worldwide than any other spore type and are the dominant outdoor spores in many areas, especially in hot climate.

#### 4. Conclusion

Railway station is a place where different type of human being comes everyday. The air of Railway station consist microorganisms which are harmful for human being. Microorganisms enter in environment through air current and contaminated the atmosphere, therefore it is necessary to survey the aeromycoflora of Railway station of Raipur. Different type of fungal spores found in the air of Railway station during investigation period.

### 5. Scope for Future work

- 1) Further studies on the occurrence of aeromycoflora in railway station air could bring about better understanding of their possible role in occupational related health hazards.
- 2) Characterization of fungal spores responsible for the induction of seasonal allergy so on that basis we can dignose the disease.



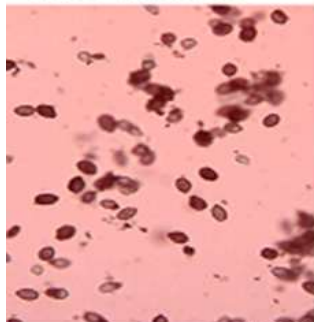
*Mucor racemosus*

(10 X 40x)



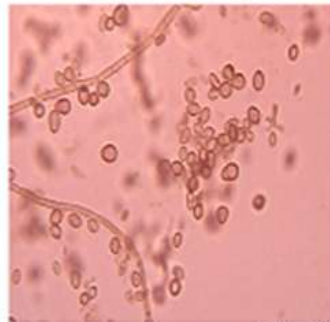
*Rhizopus stolonifer*

(10 X 10x)



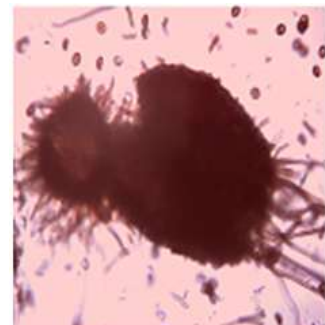
*Alysium resinae*

(10 X 40x)



*Phialophora fastigata*

(10 X 40x)



*Chaetomium globosum*

(10 X 40x)



*Khuskia oryzae*

(10 X 40x)



*Alternaria alternata*

(10 X 40x)



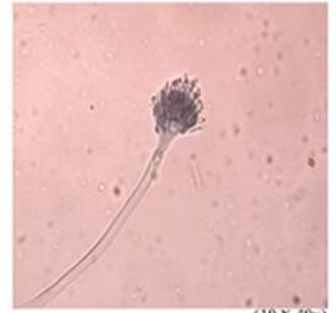
*Alternaria citri*

(10 X 40x)



*Alternaria raphani*

(10 X 40x)



*Aspergillus carneus*

(10 X 40x)



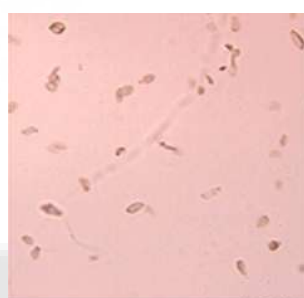
*Aspergillus clavatus*

(10 X 40x)



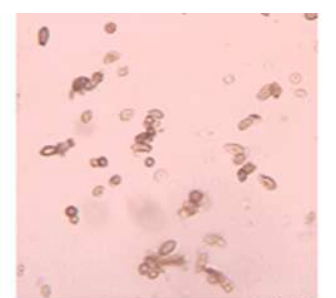
*Aspergillus flavus*

(10 X 40x)



*Cladosporium oxysporium*

(10 X 40x)



*Cladosporium sphaerospermum*

(10 X 40x)



*Curvularia lunata var. area*

(10 X 40x)



*Curvularia pallescens*

(10 X 40x)

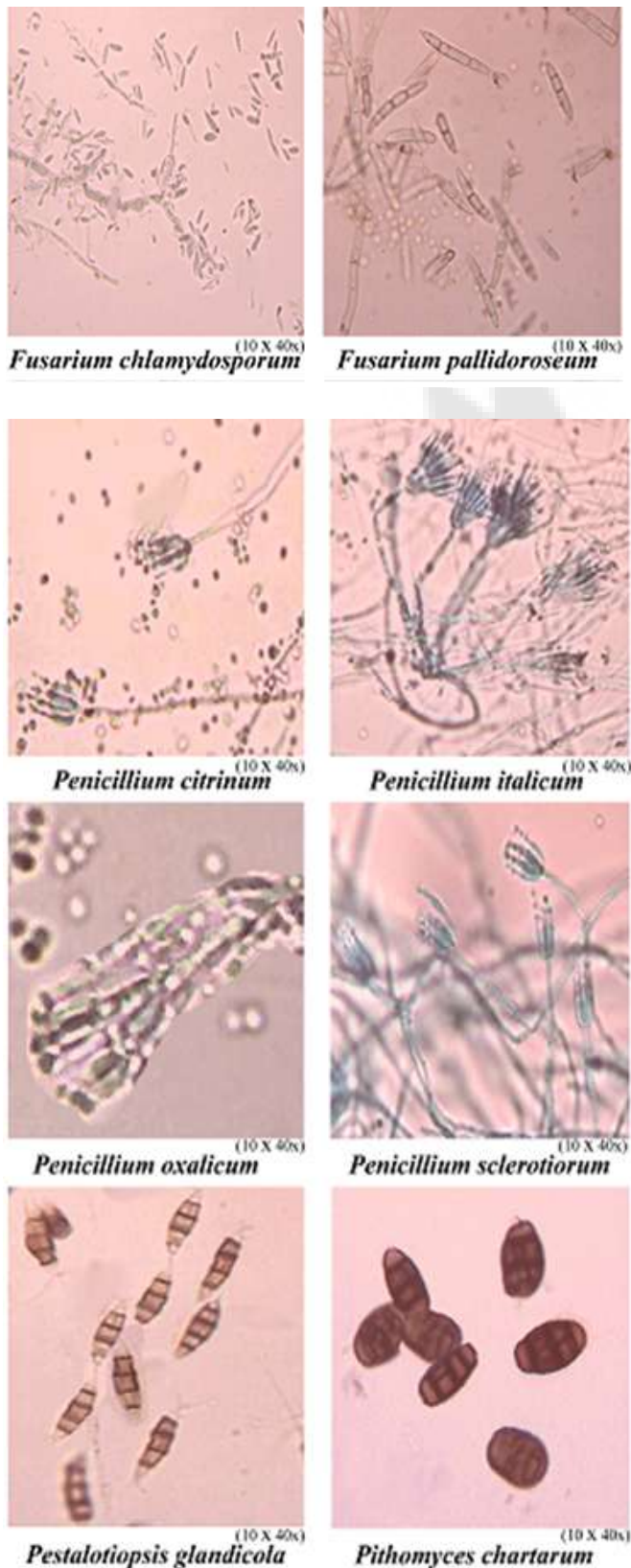


Figure 3: Photograph of fungal species found in the Railway station area

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