



## SEASONAL VARIATIONS OF INTRAMURAL AEROMYCOFLORA OF PRIVATE BUS STAND OF DARBHANGA, INDIA

Mittu Kumari\*, Indra Nath Mishra\*

\*Department of Botany, L. N. Mithila University, Darbhanga, Bihar, India.

### Abstract

This investigation deals with the seasonal variations of Intramural Aeromycoflora during different seasons of private bus stand area in Darbhanga, Bihar. The aerobiological investigation was carried out by using gravity Petriplate containing PDA (Potato Dextrose Agar) method. Some important fungus like *Alternaria alternate*, *Aspergillus niger*, *Fusarium moniliforme* are reported. Study of this fungal spores plays an important role to prevent the growth and development of these microorganisms which causes various symptoms including respiratory allergies, asthma, chronic bronchitis, allergic rhinitis, etc in human beings.

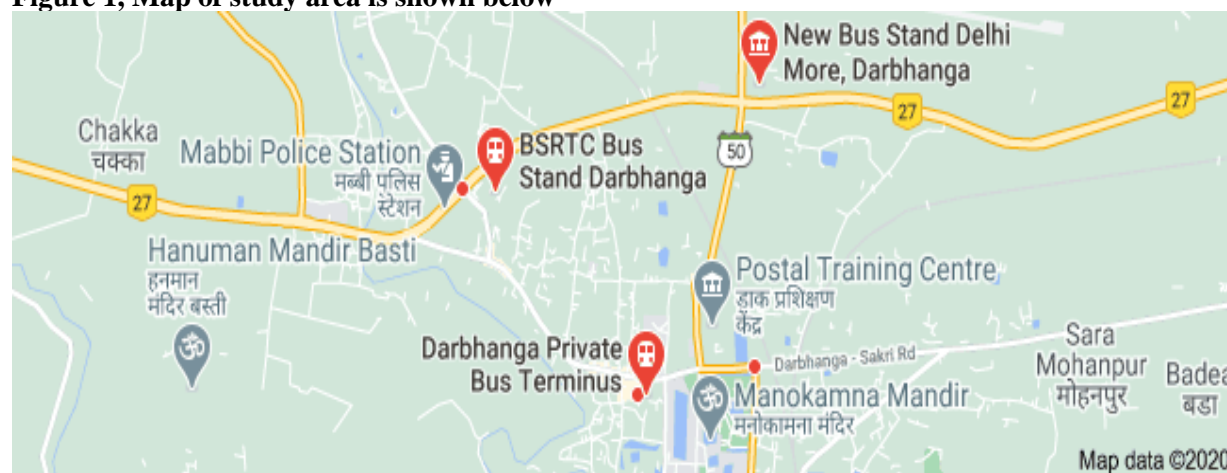
**Key Word:** Aeromycoflora, Seasonal variations, Aspergillus Species, Intramural.

Aerobiology mainly deals with the study of air borne particles of biological origin and their effect on human systems, animals and plants. The air is a mixture of several substances and surrounds the earth. It acts as a very good carrier for the dispersal of microorganisms from one place to another.

The term aerobiology came into existence during 1930 as a collective term for studies of Airspora like airborne fungal spores, pollen grains and other microorganism. So, credit goes to Maier (**Maier, 1**) of United States and subject of microbiology of the atmosphere as a special discipline. With the inception of International Biological Programme (IBP) in 1964, the term has been further extended to include research work of airborne material of biological significance. In fact, all forms of life on earth belonging both to plants and animals which become airborne and are transported partly or wholly in the atmosphere, now included in the studies of Aerobiology. (**E.B. Worthington, 2**) Edmonds also defined the Aerobiology as a scientific and multidisciplinary approach focused on the transport of airborne and biological significant materials. (**Edmonds, 3**) Fungal Spores are almost present in the air but their number and type varies with weather condition, season, and geographical location.

Seasonal variation of the Intramural aeromycoflora has been studied by a number of researcher in India. Tilak and Kulkarni have observed that maximum fungal species were recorded during winter season and minimum number of fungal species in summer season inside the caves at Aurangabad. (**Tilak & Kulkarni, 4**) Similar kind of observations have been found from aeromycoflora of greenhouse of Raipur (**Tiwari et al. 5**) and from airborne fungal spores of industrial area. (**Nayak et al., 6**)

**Figure 1, Map of study area is shown below**





### Materials & Methods

The samples of Aeromycoflora are collected twice a month at fortnightly intervals. For survey of Aeromycoflora, sterilized Petriplates containing PDA (Potato Dextrose Agar) media are exposed for 5-10 minutes at bus stand in Darbhanga, at one meter height above the ground level. Five plates are exposed inside of bus stand area. Then the Petriplates are brought into the laboratory and incubated 26±1°C for 4 to 6 days. After incubation period, fungal colonies are counted, isolated and identified with the help of available literature and finally identified by the authentic authority.

### Ecological Studies:

For ecological studies, at the incubation period of intramural and extramural Aeromycoflora, the percentage frequency and percentage contribution of the fungal flora are calculated with the help of following formula (Jadhav S K, Tiwari K L, 7)

$$\text{Percentage Frequency} = \frac{\text{No of observation in which a Species appeared}}{\text{Total number of observation}} \times 100$$

$$\text{Percentage Contribution} = \frac{\text{Total no of Colonies of a species in all the Observation taken together}}{\text{Total no of Colonies of all Species}} \times 100$$

### Metrological Data

Metrological data (temperature, relative humidity and rain fall) are collected from metrological department of Darbhanga.

### Results and Discussion

The present study depicts about seasonal variations of Intramural aeromycoflora at Darbhanga with special reference to private bus stand where gravity petriplate method was used during July 2011 to June 2012. The fungal flora is not homogenous throughout the year and show seasonal variations. Seasonal variation in the concentration of fungal species take place due to change in the climate condition like temperature and rainfall.

During the investigation, total 73 fungal species (852 colonies) belonging to 40 genera are recorded from intramural aeromycoflora of bus stand area. Maximum fungal species i.e. 60 species (443 colonies) were recorded during winter season while minimum fungal species i.e. 47 species (184 colonies) were recorded during summer season. During the rainy season, total 51 fungal species (225 colonies) of 30 genera were recorded. During the winter season, total 60 fungal species (443 colonies) belonging to 33 genera were recorded from intramural aeromycoflora of bus stand area while during the summer season, total 47 fungal species (194 colonies) of 23 fungal genera were recorded.

Various research work has taken place in India which covers seasonal variations of Intramural aeromycoflora. Minimum number of fungal species is observed from aeromycoflora inside poultry shed at Pimpri Chinchwad area, Pune (Mahajan & Choike, 8) while a study of Dr. Bhim Rao Ambedkar Hospital, Raipur showed maximum number of fungal species in winter season and minimum number of fungal species in summer season (Lall, 9). Incidence of fungal population is closely linked with the seasons and climatic conditions. Moderate temperature, high relative humidity and mid rain favored fungal growth. The higher temperature, too cold climate and heavy



rainfall do not favors fungi in the atmosphere. The spore concentration is decreased due to washing off spores by rain, but increases when it stops. (Tilak, 10)

During the study period maximum percentage frequency were observed for some fungi i.e., *Aspergillus niger* and *Mucor racemosus* (100%) followed by *Rhizopus oryzae* (83.33%), *Aspergillus carneus*, *A. flavus*, *A. terreus*, *A versicolor*, *Cladosporium sphaerospermum* (75%), *Absidia cylindrospora*, *Aspergillus nidulans*, *Curvularia lunata*, *penicilium chrysogenum*, mycelia *sterilia* white –(i),(ii) and grey (66.66%), *Mycelia sterilia* black (50%), *Scytalidium sp.* (41.66%), *Penicilium frequentans* (33%), *Stachybotys parvispora* (25%). Minimum percentage frequency (8.33%) was recorded for various fungi like- *Aspergillus stellatus*, *Choenophora cucurbitarum*, *Monila sp* etc.

*Aspergillus spp.* was recorded as most dominant fungal species in the air of poultry sheds. (Verma & Bhandari, 11). *Aspergilus niger* was observes as most common and abundant fungal in leather godown of Madras city. (Pugalmaran & Vital, 12). *Aspergillus*, *Penicillium*, *Cladosporium*, *Alternaria* and *Curvularia* were most dominant fungal species from libraries of Goalpara. (Bhattacharjee et.al., 13)

The percentage contribution of the fungal species varied with seasons. The results of seasonal percentage contribution of the total intramural aeromycoflora indicate that, maximum percentage contribution of fungal species (51.99%) are recorded in winter season, moderate percentage contribution (26.40%) in rainy season and minimum percentage contribution (21.59%) were observed in summer season. (Table1)

The member of Anamorphic fungi were the most dominant contribution throughout the season. Similar results are also made by various scientist. Maximum contribution of anamorphic fungi was reported from library at Raipur (Tiwari,14). The maximum percentage contributions (yearly) of Intramural aeromycoflora are observed for *Cladosporium cladosporides* (13.73%) followed by *Aspergillus niger* (4.69%), *Penicillium carneus* (3.16%). Similarly, *Cladosporium sp* and *Aspergillus sp* were reported most dominant fungi in Jabalpur ( Verma & Pandey, 15 )

**Table .1, Seasonal variation of Intramural aeromycoflora of private bus stand, Darbhanga**

Sl. No.	Fungal Species	Rainy Season	Winter Season	Summer Season	Grand Total of fungal colonies	Percentage Frequency	Percentage Contribution
<b>Zygomycotina</b>							
1	<i>Absidia cylindrospora</i>	1	4	4	9	66.66	1.05
2	<i>Choenophora cucurbitarum</i>	1	-	-	1	8.33	0.11
3	<i>Circinella mucoroides</i>	6	3	4	13	58.33	1.52
4	<i>Cunninghamella echinulata</i>	-	1	-	1	8.33	0.11
5	<i>Mucor racemosus f racemosus</i>	13	5	10	28	100	3.28
6	<i>Rhizopus oryzae</i>	5	8	8	21	83.88	2.46
7	<i>Syncephallastrum racemosum</i>	1	5	2	8	50	0.93
	<b>Total no. of fungal colonies</b>	<b>27</b>	<b>26</b>	<b>28</b>	<b>81</b>		
	<b>Total no. of fungal genera</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>7</b>		
	<b>Total no. of fungal species</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>7</b>		
<b>Ascomycotina</b>							
8	<i>Chaetomium globosum</i>	1	-	1	2	16.66	0.23
9	<i>Diaporthe sp.</i>	1	-	-	1	8.33	0.11
10	<i>Emericella versicolor</i>	1	1	-	2	16.66	0.23



11	<i>Eurotium amesteldami</i>	2	8	3	13	58.33	1.52
12	<i>Neosartoria fischeri</i>	6	12	-	18	33.33	2.11
13	<i>Theilavia boothii</i>	1	-	1	2	16.66	0.23
	<b>Total no. of fungal colonies</b>	<b>12</b>	<b>21</b>	<b>5</b>	<b>38</b>		
	<b>Total no. of fungal genera</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>6</b>		
	<b>Total no. of fungal species</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>6</b>		
	<b>Basidiomycotina</b>						
14	<i>Phaenerochetes chrysosporium</i>	-	1	-	1	8.33	0.11
	<b>Total no. of fungal colonies</b>	-	1	-	1		
	<b>Total no. of fungal genera</b>	-	1	-	1		
	<b>Total no. of fungal species</b>	-	1	-	1		
	<b>Anamorphic fungi</b>						
15	<i>Altenaria alternata</i>	4	13	3	20	58.33	2.34
16	<i>A. Citris</i>	-	4	-	4	16.66	0.46
17	<i>Aspergillus carneus</i>	15	9	3	27	75	3.16
18	<i>A. flavus</i>	5	6	12	23	75	2.69
19	<i>A.flavus var.albus</i>	-	2	2	4	33.33	0.46
20	<i>A. fumigatus</i>	2	2	5	9	50	1.05
21	<i>A. japonicus</i>	9	1	11	21	50	2.46
22	<i>A.nidulans</i>	6	5	5	16	66.66	1.87
23	<i>A.nidulans var acristatus</i>	1	3	6	10	33.33	1.17
24	<i>A. niger</i>	11	13	16	40	100	4.69
25	<i>A. ochraceus</i>	3	2	1	6	41.66	0.7
26	<i>A. parasiticus</i>	3	-	2	5	33.33	0.58
27	<i>A. stellatus</i>	-	-	2	2	8.33	0.23
28	<i>A. terreus</i>	7	5	8	20	75	2.34
29	<i>A. USTUS</i>	2	3	-	5	25	0.58
30	<i>A. versicolor</i>	15	9	2	26	75	3.06
31	<i>Aspergillus</i>	2	2	-	4	16.66	0.46
32	<i>Cladosporium cladosporoides</i>	5	109	3	117	50	13.73
33	<i>C. sphaerospermum</i>	12	71	23	106	75	12.44
34	<i>Corynespora cassilicola</i>	1	2	-	3	25	0.35
35	<i>Curvularia lunata</i>	9	8	3	20	66	2.34
36	<i>C. lunata var aerea</i>	4	5	2	11	41.66	1.29
37	<i>Diplococcium sp.</i>	2	1	-	3	16.66	0.35
38	<i>Drechslera australiensis</i>	-	1	1	2	16.66	0.23
39	<i>D. halode</i>	-	1	2	3	25	0.35
40	<i>D. aryzae</i>	-	-	1	1	8.33	0.11
41	<i>Epicoccim purpurascens</i>	-	1	-	1	8.33	0.11
42	<i>Fusarium moniliforme</i>	-	6	2	8	25	0.93
43	<i>F. pallidoroseum</i>	3	3	-	6	25	0.7

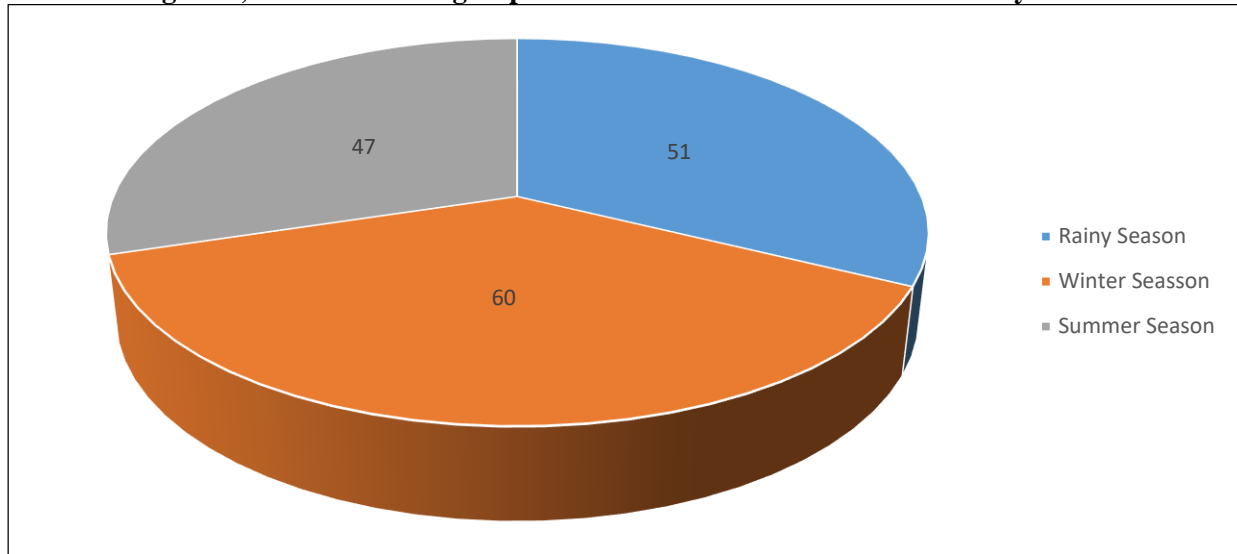


44	<i>f.solani</i>	6	6	-	12	58.33	1.4
45	<i>Gliocladium sp.</i>	2	-	-	2	16.66	0.23
46	<i>Graphium sp.</i>	-	1	-	1	8.33	0.11
47	<i>Monilia sp.</i>	-	-	1	1	8.33	0.11
48	<i>Monodictys levis</i>	-	2	1	3	25	0.35
49	<i>Monodictys sp.</i>	-	-	1	1	8.33	0.11
50	<i>Nigrospora oryzae</i>	1	7	-	8	41.66	0.93
51	<i>N. sphaerica</i>	-	6	-	6	16.66	0.7
52	<i>Paecilomyces variotii</i>	4	2	1	7	41.66	0.82
53	<i>Penicilium chrysogenum</i>	7	16	6	29	66.66	3.4
54	<i>P. digitatum</i>	5	4	3	12	50	1.4
55	<i>P. frequentans</i>	-	3	2	5	33.33	0.58
56	<i>P. lilacinum</i>	-	-	1	1	8.33	0.11
57	<i>P. rubrum</i>	3	-	1	4	25	0.46
58	<i>Perioconia Saraswarpurensis</i>	-	2	1	3	16.66	0.35
59	<i>Phoma fickeli</i>	5	2	1	8	41.66	0.93
60	<i>P. glomerata</i>	4	4	-	8	41.66	0.93
61	<i>Pithomyces chartarum</i>	1	7	-	8	25	0.93
62	<i>Scytalidium sp.</i>	5	-	2	7	41.66	0.82
63	<i>Stachybotrys elegans</i>	-	1	-	1	8.33	0.11
64	<i>S. parvispora</i>	-	6	-	6	25	0.7
65	<i>Trichoderma harzianum</i>	-	1	1	2	16.66	0.23
66	<i>T. viride</i>	2	1	-	3	16.66	0.35
67	<i>Trichothecium roseum</i>	1	4	-	5	25	0.58
68	<i>Torula herbarum</i>	2	2	-	4	16.66	0.46
69	<i>Unknown new sp.</i>	-	2	-	2	8.33	0.23
	<b>Total no. of fungal colonies</b>	<b>169</b>	<b>366</b>	<b>137</b>	<b>672</b>		
	<b>Total no. of fungal genera</b>	<b>17</b>	<b>22</b>	<b>14</b>	<b>25</b>		
	<b>Total no. of fungal species</b>	<b>35</b>	<b>46</b>	<b>35</b>	<b>55</b>		
	<b><i>Mycelia sterilia</i></b>						
70	<i>Mycelia sterilia white - (i)</i>	6	5	3	14	66.66	1.64
71	<i>Mycelia sterilia white - (ii)</i>	5	5	5	15	66.66	1.76
72	<i>Mycelia sterilia black</i>	1	4	3	8	50	0.93
73	<i>Mycelia sterilia grey</i>	5	15	3	23	66.66	2.69
	<b>Total no. of fungal colonies</b>	<b>17</b>	<b>29</b>	<b>14</b>	<b>60</b>		
	<b>Total no. of fungal genera</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>		
	<b>Total no. of fungal species</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>		
	<b>Grand total no. of Colonies</b>	<b>225</b>	<b>443</b>	<b>184</b>	<b>852</b>		
	<b>Grand total no. of genera</b>	<b>30</b>	<b>33</b>	<b>23</b>	<b>40</b>		
	<b>Grand total no. of Species</b>	<b>51</b>	<b>60</b>	<b>47</b>	<b>73</b>		



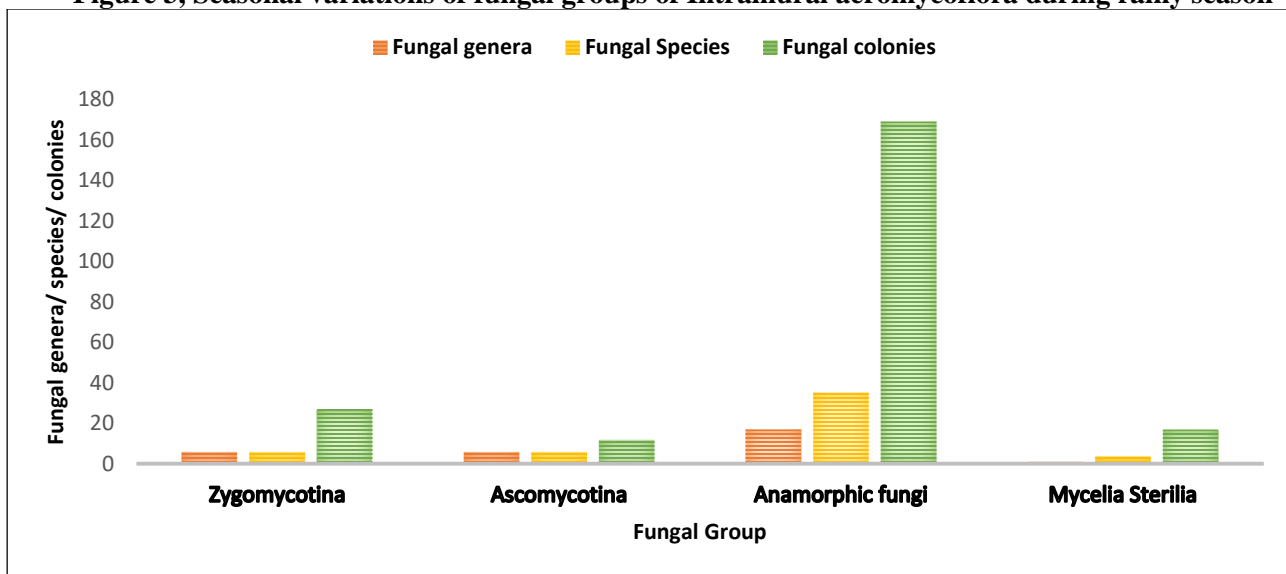
Seasonal variations affect the distribution of Aermycoflora of corresponding area. Maximum fungal species i.e., 60 species were recorded during winter season and minimum fungal species i.e.; 47 species were recorded during summer. (*Fig. – 2*)

**Figure 2, Season wise fungal species distribution of Intramural Aeromycoflora**



During the rainy season, total 51 fungal species (225 colonies) of 30 genera were recorded. Out of them, 6 fungal species (27 colonies) of 6 genera from Zygomycotina, 6 fungal species (12 colonies) of 6 genera from Ascomycotina, 35 fungal species (169 colonies) of 17 genera from Anamorphic fungi and 4 species (17 colonies) of 1 genera from Mycelia sterilia were recorded. (*Fig. – 3*)

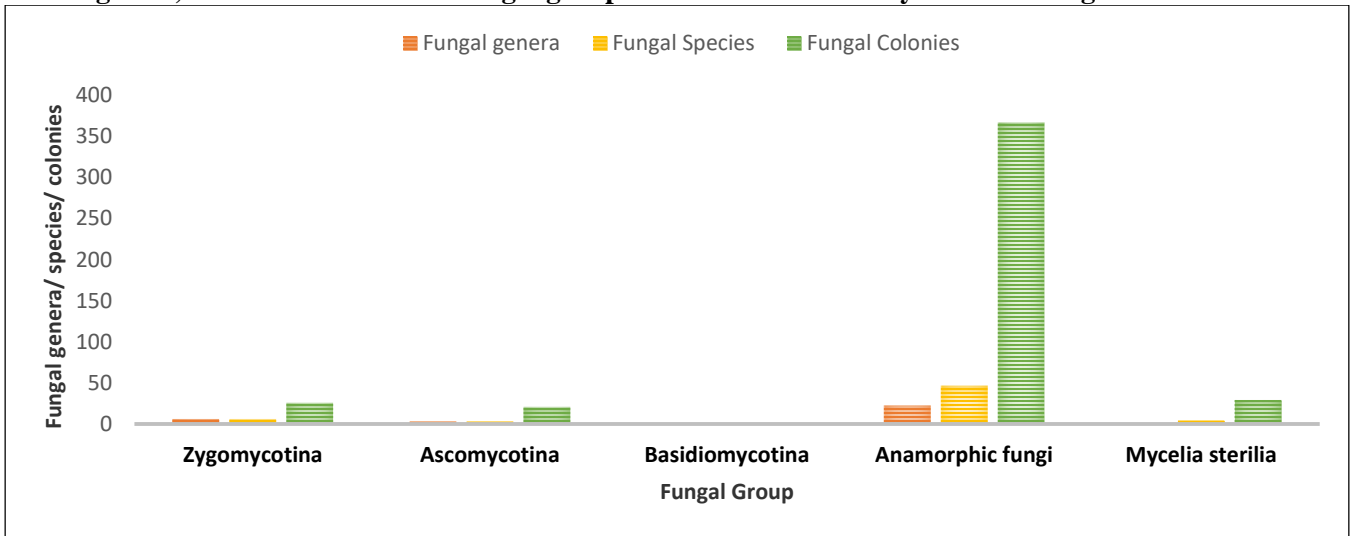
**Figure 3, Seasonal variations of fungal groups of Intramural aeromycoflora during rainy season**





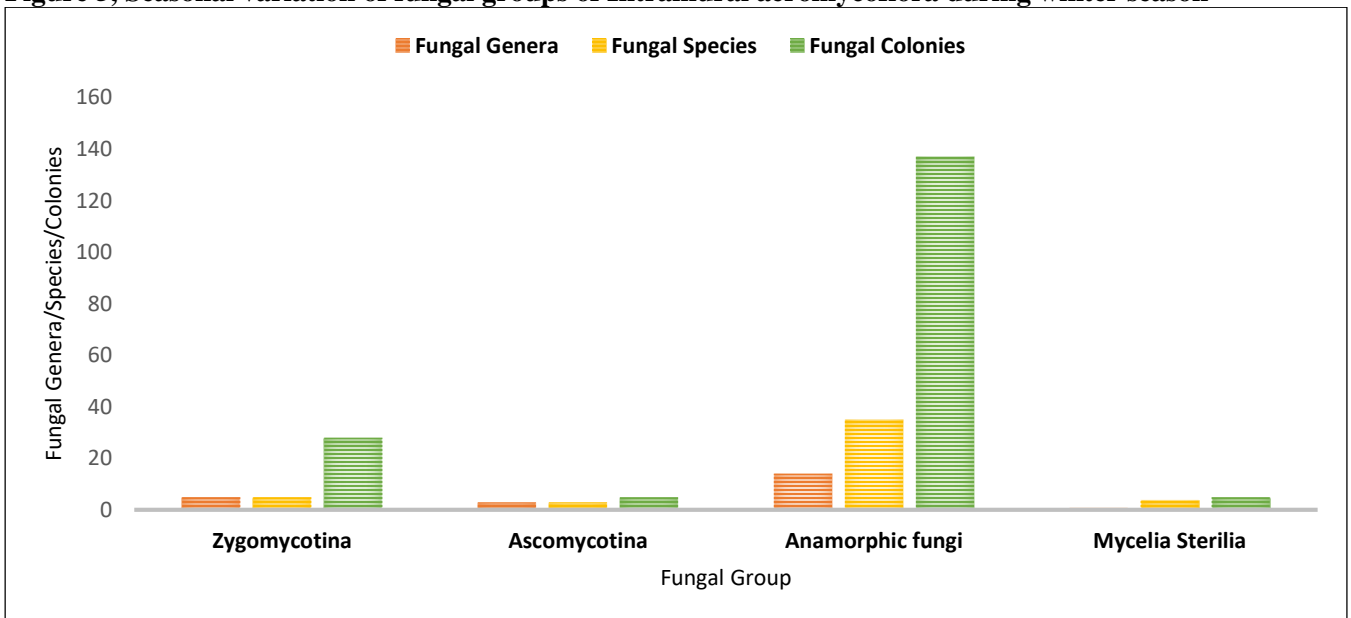
During the winter season total 60 fungal species (443 colonies) belonging to 33 genera were recorded from intramural aeromycoflora of bus stand area. Among the total recorded fungal population, 6 fungal species (26 colonies) of 6 genera belonging to group Zygomycotina, 3 fungal species (21 colonies) of 3 genera Basidiomycotina, 46 fungal species (336 colonies) of 22 genera belonging to group Anamorphic fungi and 04 species (29 colonies) of 1 genera belonging to group of Mycelia sterilia were recorded. (Fig – 4)

**Figure 4, Seasonal variation of fungal groups of Intramural aeromycoflora during winter season**



During the summer season, total 47 fungal species (194 colonies) of 23 fungal genera were recorded. Among them, 5 fungal species (28 colonies) of 5 genera from Zygomycotina, 3 fungal genera from Ascomycotina, 35 fungal species (137 colonies) of 14 genera from Anamorphic Fungi and 4 species (14 colonies) of 1 genus were recorded from Mycelia sterilia. (Fig – 5)

**Figure 5, Seasonal variation of fungal groups of Intramural aeromycoflora during winter season**





## Conclusion

The detailed study on Intramural Aeromycoflora of bus stand area, Darbhanga reveals that fungal species of bus stand area are varied with seasons. In the present study different sources of Aeromycoflora in the bus stand area are observed and for the growth and development of different fungal species favorable condition are analyzed.

These finding are beneficial for the collection of data for further analysis. To prevent the growth and development of these microorganisms inside the private bus stand area, we have to clean and monitor this area properly and eradicate the diseased plants regularly of that area to find significant application in human health.

## Acknowledgements

This research is supported by the Department of Botany, L. N. Mithila University, Darbhanga, Bihar, 846008, India. I am also indebted to Dr. Indra Nath Mishra, Retd. Professor, Department of Botany, L. N Mithila University, Darbhanga for his guidance and helping me putting pieces together.

## References

1. Maier, F.C., 1930 – Collecting microorganisms from the arctic atmosphere. Sci. New York.40.p:5.
2. E.B. Worthington, The Evolution of IBP (Cambridge, 1975)
3. Edmonds, R.L. 1979 – Aerobiology – The ecological system approach. Ed. By Edmonds R.L, Dowden Hutchinson & Ross, P: 386
4. Tilak, S. T. and Kulkarni, R. L., Microbial contents of air inside and outside the caves at Aurangabad. Curr. Sci. 23, 1972, 850-851.
5. Tiwari, K.L., Sahu, K. and Jadhav, S.K., Aeromycoflora at Green House of Botanical garden of Science College Raipur, Ad. Plant Sci. 18 (1), 1995, 46-51.
6. Nayak B. K. Nanda, A. and Bahera, N., Airborne fungal spores in an industrial area : seasonal and diurnal periodicity
7. Jadhav S K, Tiwari K L, (1994). “Aeromycoflora of Ravan village”, Indian Bot. Rept., 1 (1), pp 33-36.
8. Mahajan, M.C. and Cholke, P.B, Study of aeromycoflora inside poultry shed at Pimpri Chinchwad area. Abst. 14<sup>th</sup> national conference, Aerobio. Raipur.p:41. 2007
9. Lall, B.M., Studies of indoor and outdoor aeromycoflora of Dr. Bhim Rao Ambedkar Hospital, Raipur, Ph.D. Thesis, Pt. Ravishankar Shukla University, Raipur, 2008
10. Tilak, S.T., Atlas of airborne pollen grain and fungal spores. Vijayanti Prakashan, Aurangabad.p:316, 1989
11. Verma, K.S. and Bhandari S, Aeromycological survey inside the broiler and layer shed, Indian journal of animal sciences.62(12), p:1147-1149, 1992
12. Pugalmaran, M. & Vittal B.R.R, Aeromycological survey of indoor environment in leather godown of Madras city, 5<sup>th</sup> International Conference of Aerobiology, Bangalore,p.143-147, 1994
13. Bhattacharjee, K, Dega G, Devi, N. Sama, G.C. and Deka D, Comparative study of Aeromycological flora of two libraries. 15<sup>th</sup> National conference on Aerobiology & National Symposium on Airspora – impact on plant, animal and human health, Manipur University, Imphal.p:50, 2009
14. Tiwari, K.L. and Jadhav, S.K. and Saluja,P.K, Biodiversity of the aerofungi of Library -1 at Raipur. 15<sup>th</sup> National conference on aerobiology and National symposium on airspora- Impact on plant, animal and human health, Manipur University, Imphal, p:47, 2004
15. Verma, K.S. and Pandey, M., Airborne fungal spores in a hospital ward at Jabalpur. PROC. National Acad.Sci.India.62(B)III.P:371-374, 1992.