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Investigations on Aeromycology in the Indoor Environment (O.T.) of the Rural Healthcare Center in Sindewahi

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ABSTRACT

In every month of the year, microfungi are found in the interior environment in every area of healthcare facilities. Not even the operating rooms are free of fungi. Fungal-free environments in operating rooms are only temporary when fumigation is performed both before and after using the space. For an average of two years, deuteromycotina dominated indoor air in terms of both quantity and quality, followed by phycomycotina and ascomycotina. The spores of fungi varied with the season. The wet season (June to September) had the highest concentration of fungal spores, which were then followed by winter (October to January) and summer. Fungal spore concentration varies month to month. From July to December, the highest instances were noted, and from March to May, the lowest. There was variation in the incidence of CFUs/M3 in the indoor air. The variations could be caused by the monthly weather patterns and internal sources that encourage the development and spread of fungi. This examination of different areas of healthcare facilities makes it abundantly evident that employees and patients have a very high chance of coming into contact with allergenic fungus spores. Human disease is caused by fungi and their poisons.

Keywords :- Indoor, Aeromycology, Rural

I. INTRODUCTION

Rural Healthcare Centre Sindewahi situates at latitude 20.283220 and longitude 79.6667600 of India. Depending upon the temperature, humidity and rainfall climate of this region divided into three seasons i.e. summer, winter and rainy season. The summer season starts from February to May and maximum temperature reaches up to 45 to 47c. The rainfall generally occurs from June to September while winter starts from October to month of January

and minimum temperature reaches up to 8 to 9c. For studying the indoor aeromycoflora of rural health care centre the air sampling was done in Operation Theater (O.T.). The air sampling was done regularity twice in the month for consecutive two years i.e. Aug.2014-July2016.In Rural Healthcare Centre Sindewahi Operation Theater of rural health care center is utilized only for family planning operations, particularly from the month of December to January. Before the operation the O.T. was sterilized by fumigation process. For the sterilization formaldehyde fumigation method is used. The air samples were collected from O.T. of rural health care center Sindewahi regularly by both petriplate exposure method and volumetric air sampler method.

Fig. 4.1.:- Latitude and Longitude Position of Rural Healthcare Centre Sindewahi

Results and Discussion

Petriplate exposure method

Indoor aeromycoflora in Rural Healthcare Centre Sindewahi

In Rural health care centre Sindewahi the fungal aeromycospora were collected from O.T. Petripalte exposure method is the oldest method for collection and identification of air borne fungal spores. The numbers of fungal spores which are settle on the surface of petriplate containing agar media are incubated for 4-7 days interval at room temperature. After 5-7 days colonies are counted and identified upto genera/species.

By the petriplate exposure method total 71 fungal species belonging to 20 different fungal genera were recovered. Besides these white, black, and orange sterile mycelia were also isolated in two years (Aug2014- July 2016) research work. Out of 20 identified genera, two genera *Mucor* (7species) and *Rhizopus* (4 species) belongs to Phycomycotina. three fungal genera *Chaetomium (3fungal species), Epicoccum (2 fungal species), Geotrichum(3fungal species)*belongs to Ascomycotina and remaining 15 fungal genera viz.*Aspergillus (12 fungal species), Penicillium(7 fungal species), ,Alternaria, Cladosporium, Curvularia, Trichothecium (each 4 fungal species), Fusarium, Candida , Phoma,Torula (each 03 fungal species), Cercospora , Drechlera, Helminthosporium,Nigrospora, Trichoderma (each 01 fungal species*) were representingDeuteromycotina. (Table No.4.1).

In two years study Deuteromycotina were dominant with 66.39 %(52 fungal species), followed by Phycomycotina with 15.28% (11 fungal species) and *Ascomycotina* with 7.23 % (8 fungal species). Sterile mycelium 11.09 % were recorded in rural healthcare centre Sindewahi during the research period.

In 1st year study *Deuteromycotina* were recorded 69.30%, Phycomycotina were noted 14.01% and Ascomycotina were noted 7.12%.
In 2nd year study *Deuteromycotina* were 64.62%, Phycomycotina were 16.05% and *Ascomycotina* were 7.29%. (Table No. 4.2).
Total 4678 fungal colonies were recorded in rural health care centre Sindewahi during the two year of research period i.e. 2014-2016. In year 2014-2015 total 1769 fungal colonies were recovered while in year 2015-2016 total 2909 fungal colonies were isolated. During the two years of study *Aspergillu*s were dominant having 659 colonies (14.08%) followed by *Penicillium570 colonies (12.18%), Mucor* 458 colonies (9.79 %),*Alternaria*432 colonies (9.23 %),*Rhizopus* ***257****colonies (*5.49%), *Curvularia* 179 colonies (3.82 %),*Cercospora 157colonies* (3.35 %) *Fusarium 145 colonies* (3.09%),Phoma 139 colonies (2.97%), Epicoccum 136 colonies (2.9%) Geotrichum 134 colonies (2.86%) *Torula 125colonies (*2.62%), *Cladosporium 123 colonies*(2.62%), *Helminthosporium*113 colonies (2.41%), *Trichoderma 110 colonies* (2.35%), *Nigrospora*105 colonies (2.24 %), *Trichothecium*89 colonies (1.90%) *Drechslera* 85 colonies (1.81%),Candida75 colonies (1.6 %), Chaetomium 68 colonies (1.47%). Along with these *White sterile mycelia* 366 colonies (7.82%), *Black sterile mycelia*145 colonies (3.09%) and *Orange sterile mycelia 8colonies* (0.17%) was noted in two years investigation. (Table No. 4.3).

In 1st year study Aspergillus were dominant having 235 colonies (13.28%) followed by *Penicillium 223 colonies (12.6%), Mucor*148 colonies (8.36 %) ,*Alternaria* 138 colonies (7.8 %),*Rhizopus****100****colonies* (5.08 %), *Curvularia*93 colonies (5.25 %),*Cercospora 87 colonies* (4.91 %) *Helminthosporium*71 colonies (4.01%), Geotrichum 62 colonies (3.5%), *Fusarium 57 colonies* (3.22%),*Cladosporium 53 colonies*(2.99%),*Nigrospora*47 colonies (2.85 %), *Trichoderma 44 colonies* (2.48%), *Drechslera*42 colonies (2.37%),*Torula, Trichothecium 36colonies (*2.03%), Chaetomium,Phoma 33 colonies (1.87%), Epicoccum, Candida 31 colonies (1.75%) , besides these *White sterile mycelia* 125 colonies (7%), *Black sterile mycelia*36 colonies (2.03%) and *Orange sterile mycelia 2 colonies* (0.247%) was noted in two years investigation. (Table No. 4.3).

In 2nd year of study also *Aspergillus* were dominant having 424 colonies (15.19%) followed by *Penicillium 347 colonies (11.92%), Mucor*310 colonies (10.65 %) ,*Alternaria* 294 colonies (10.10 %),*Rhizopus* ***157****colonies* (5.39 %), %),Phoma 106 colonies (3.5%), Epicoccum 105 colonies (3.6%),*Torula 89 colonies(3.05%), Fusarium 88 colonies* (3.02%),*Curvularia* 86 colonies (2.95 %),*Cladosporium 70 colonies*(2.4%) Geotrichum 72 colonies (2.47%), *Cercospora 70 colonies* (2.4 %), %), *Trichoderma 66 colonies* (2.26%), *Nigrospora* 58 colonies (1.99 %), *Trichothecium53 colonies (*1.82%),Candida 44 colonies (1.51%), *Drechslera* 43 colonies (1.47%),*Helminthosporium* 42 colonies (1.44%), Chaetomium 35 colonies (1.2%). Along with these *White sterile mycelia*241 colonies (8.28%), *Black sterile mycelia*109 colonies (3.7%) and orange sterile mycelia 3 colonies (0.20%) were noted in two years investigation. (Table No. 4.3).

In 1st year investigation (Aug2014- July 2015) total 1769 fungal colonies were isolated, out of which minimum 308 fungal colonies were recorded from Operation Theater (O.T.) (Table No. 4.4).

In 1st year study shows that,seasonal variation also exhibited by indoor aeromycoflora. In rainy season (June to September) maximum 861(48.67%) fungal colonies were isolated followed by 638(36.06%) colonies in winter season (October to January) and minimum 270(15.26%) colonies in summer (February to May)were recorded. In whole study maximum 273 fungal colonies were recorded in month of July followed by Aug., Sept., Oct., Nov.,

Dec., Jan.,June, Feb., Mar., Apr. and minimum 44 fungal colonies were recorded in month of May. (Table No. 4.4).

In 2nd year investigation (Aug2015- July 2016) total 2909 fungal colonies were isolated, out of which minimum 384 fungal colonies were recorded from Operation Theater (O.T.) (Table No. 4.5).

In 2nd year study shows that , seasonal variation changes the concentration of fungal spores in air, in rainy season (June to September) maximum 1284 (44.13%) fungal colonies were isolated after 1069 (36.74%) colonies in winter season (October to January) and minimum 556(19.11%) colonies in summer(February to May)were recorded. In whole study maximum 382 fungal colonies were recorded in month of July followed by Aug., Sept., Oct., Nov., Dec., Jan., June Feb., Mar., Apr. and minimum 77 fungal colonies were recorded in month of May. (Table No. 4.5).

During 1st years (Aug. 2015- July 2016) of study , in month of April and May only a 5 genera viz. *Aspergillus* ,*Penicillium* ,*Alternaria*,*Mucor* and *Rhizopus* along with *White sterile mycelia* were recorded from indoor air atmosphere of O.T. of Rural healthcare centre Sindewahi. While in 2nd years of study along with these 5 genera *Curvularia*was also recorded. (Table No. 4.14 and 4.15).

Indoor aeromycoflora in Operation Theater (O.T.)

In Rural health care centre sindewahi the air sample were collected from O.T. By using petriplate exposure method total 39 fungal species belongs to 7 different fungal genera were isolated. Beside these white sterile mycelia, was also isolated in two years (Aug2014- July 2016) of research work. In 1st year (Aug 2014- July 2015) of study out of 7 fungal genera, 2 fungal genera i.e. Mucor (7fungal species), and Rhizopus (4fungal species) represent to Phycomycotina. and 5 fungal genera i.e. *Aspergillus* (12fungal species), Penicillium (7 fungal species) ,*Alternaria, Curvularia (each 4 fungal species) ,Cercospora(1 fungal species)* represent to *Deuteromycotina*. (Table No. 4.1).

Total 692 fungal colonies were recorded in O.T. of rural health centre Sindewahi during the two year research period i.e. Aug. 2014- July 2016.

In 1st year investigation (Aug 2014- July 2015) total 308 fungal colonies were isolated. Seasonal variation also shown by fungal spores in indoor air but in O.T. fumigation was done before and after the operation therefore at that time fungal spores were not recorded. In rainy season (June to September) maximum 138(44.80%) fungal colonies were isolated followed by108(35.06%) colonies in winter season (October to January) and minimum 62(20.2%) colonies in summer (February to May)were recorded.In whole study maximum 43 fungal colonies were recorded in month of July followed by Aug.,Sept., Nov Dec., Nov.,Oct., June, Jan. Mar., Feb., April, May and minimum 14 fungal colonies were recorded in month of May. (Table No. 4.8).

In 2nd year investigation (Aug2015- July 2016) total 99 fungal colonies were isolated. In rainy season (June to September) maximum 191 (49.73%) fungal colonies were isolated ,138 (35.93%) colonies in winter season (October to January) and 55 (14.32%) colonies in summer(February to May)were recorded. In whole study maximum 56 fungal colonies were recorded in month of July followed by in Aug., Sept., Oct., Nov., Dec. June, Jan., Feb., March, Apr. and minimum 12 fungal colonies were recorded in month of May. (Table no. 4.8).

In two years study Deuteromycotina (53.25 %) were dominant with 28 fungal species, followed by Phycomycotina with 22.83% (11fungal species). Besides these White sterile mycelia was 15.46 % were recorded in rural healthcare centre Sindewahi during a research period. No black and orange sterile mycelia were observed.
In 1st year study *Deuteromycotina* were noted as 50%, and Phycomycotina were noted as 21.42%.
In 2nd year study *Deutoromycotina* were 56.51 % and Phycomycotina were 23.95% (Table no.4.13).
Throughout the two years study *Aspergillus* were dominant having 144 colonies (20.8%) followed by *Penicillium130 colonies (18.78%), Mucor*93 colonies, (13.43%) ,*Alternaria* 105 colonies (15.17 %),*Rhizopus 11 colonies* (6.04 %), *Curvularia , Cercospora 24 colonies (3.46%).*Other than these *White sterile mycelia*107colonies (15.46%) wererecorded in two years of investigation (Table No. 4.13).
In 1st year investigation (Aug2014- July 2015) , *Aspergillus* were dominant having 62 colonies (20.12 %) followed by *Penicillium 60 colonies (19.48 %), Mucor*41 colonies (13.33 %), Alternaria40 colonies (12.98%),*Rhizopus 25 colonies* (8.1%),*Curvularia , Cercospora (7.79%).* Other than these *White sterile mycelia*32 colonies (10.38%) were noted. (Table No. 4.13).
In 2nd year investigation (Aug2015- July 2016), Aspergillus were dominant having 35 colonies (35.35%) followed by *Penicillium 21 colonies (21.21%), Mucor*12 colonies (12.12%) ,*Alternaria* 11 colonies (11.11%),*Curvularia*, *9* colonies (9.09 %),*Rhizopus 7 colonies* (7.07%). Other than these *White sterile mycelia* 9 colonies (9.09%) was noted. (Table No. 4.13).

Volumetric Air Sampler Method

Indoor aeromycoflora in Rural Healthcare Centre Sindewahi

Air sampler method is easy and convenient method to study the concentration of indoor airborne fungal spores. In this study Hi media air sampler Mark II was used for collecting aerospora.
By using Hi media air sampler mark II total 38360 CFU's/M^3 were trapped in rural healthcare centre Sindewahi, during two years of research period.
In 1st year (Aug. 2014- July 2015) total 16470 CFU's/M^3 were recorded, out of which 1920 CFU's /M^3 were trapped in O.T.
The concentrations of indoor fungal spores were affected by seasonal variation. Maximum CFU's/M^3 were recorded in rainy season followed by winter and minimum in summer. In Aug 2014-July 2015, total 7765 CFU's/M^3(41.74%) recorded in rainy season,5709 CFU's/M^3(34.60%) recorded in winter season and 2960 CFU's /M^3 (17.97%) recorded in summer season. Maximum 2530 CFU's/M^3 were recorded in month Of July followed by Aug., Sept, Oct, Nov, Dec, Jan, June, Feb., Mar., April, and minimum 460 CFU's/M^3 were trapped in Month of May. (Table No. 4.18).
In 2nd year of research period (Aug. 2015- July 2016) , total 21890 CFU's /M^3were recorded, out of which 2960 CFU's /M^3 were isolated in O.T. The concentration of fungal spores was affected by seasonal variation.
Maximum CFU's/M^3 were recorded in rainy season followed by winter and minimum in summer. In Aug 2015-July 2016, total 8935 CFU's/M^3(40.81%) recorded in rainy season,7790 CFU's/M^3(35.58%) recorded in winter season and 5215 CFU's/M^3 (23.82%)recorded in summer season. Maximum 2585 CFU's/M^3 were recorded in month Of July followed by Aug., Sept., Nov., Oct., Dec., Jan., Feb., June, Mar., April., and minimum 935 CFU's/M^3 were recorded in Month of May.(Table No.4.19).

Indoor aeromycoflora in Operation Theater(O.T.)

By using Hi media air sampler mark II, total 4880 CFU's/M^3 were recorded in O.T. of Rural healthcare centre Sindewahi during two years of research period (Aug. 2014 – July 2016).

In 1st year of research (Aug.2014- July2015), total 1920 CFU's/M^3were recorded. The concentration of fungal spores was affected by seasonal variation. Maximum CFU's/M^3 were recordedin rainy season followed by winter and minimum in summer. 1140 CFU's/M^3(59.37%) recorded in rainy season,530 CFU's/M^3(27.60%) recorded in winter season and 250 CFU's/M^3(13.02%) recorded in summer season. Maximum 265 CFU's/M^3 were recorded in month Of July followed by Aug., June, Sept., Oct., Nov., Dec., Jan., Mar., Feb., April respectivelyand minimum 30 CFU's/M^3were recorded in Month of May (Table No. 4.19 & 4.21).

In 2ndyear of research (Aug.2015-July2016), total 2960 CFU's/M^3were recorded, The concentration of fungal spores varies according to the seasonal variation. Maximum CFU's/M^3 were recordedin rainy season followed by winter and minimum in summer. 1445 CFU's/M^3(48.81%) recorded in rainy season,1000 CFU's/M^3(33.78 %) recorded in winter season and 515 CFU's/M^3(17.39%) recorded in summer season. Maximum 445 CFU's/M^3 were recorded in month Of July followed byAug., June,Sept., Jan., Feb., March, Sept., Oct., Nov., Dec.,Jan., Feb., March, April, , and minimum 105 CFU's/M^3 were recorded in Month of May. (Table No. 4.20& 4.21).

Conclusions

All the sections of healthcare centers show the presences of microfungi in the indoor environment in all the month of the year. Even the operation theatres are not the fungal free. Only when there fumigation is done before and after using the operation theatre fungal free environment prevails for some period in operation theatres. Quantitatively and qualitatively, *deuteromycotina* were predominant in indoor air to the total aerospora followed by *phycomycotina* and *ascomycotina* on an average of two years. Fungal spores exhibited seasonal variation. Maximum concentration of fungal spores were observed in rainy season (June-Sept.) followed by winter (October-January) and then summer Concentration of fungal spores different from month to month. The highest incidences were recorded from July to December and lowest from March to May. The incidence of CFU's/M^3 in the indoor air was not homogeneous. The different may be due to prevail climate during each month and intramural sources that supports the growth and proliferation of fungi. It is clear from this study of various sections of healthcare centers that patients and workers are the high risk of being exposed to very high concentration of allergic fungal spores. Fungi and their toxins cause illness in human beings.

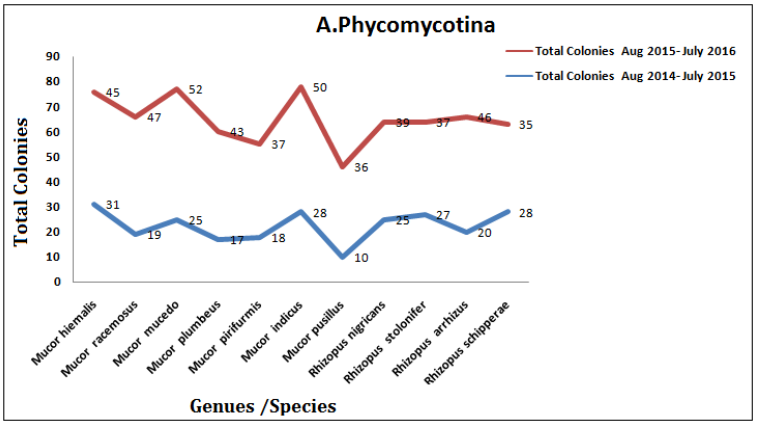
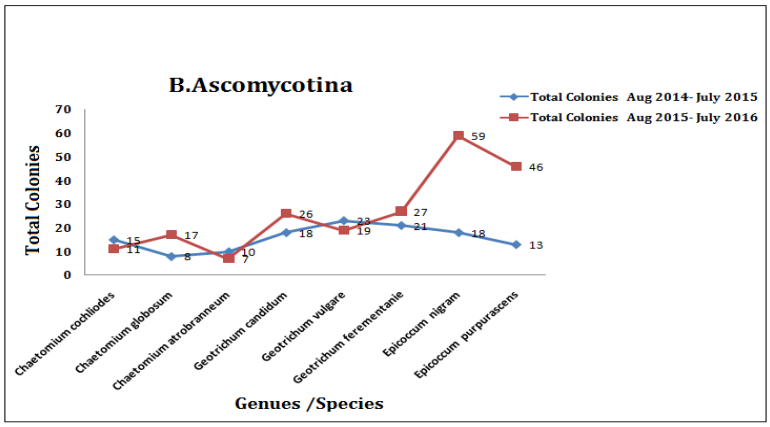


Fig. Total No of Fungal Colonies of Different Fungal Species/Genera & Their Percentage Contribution



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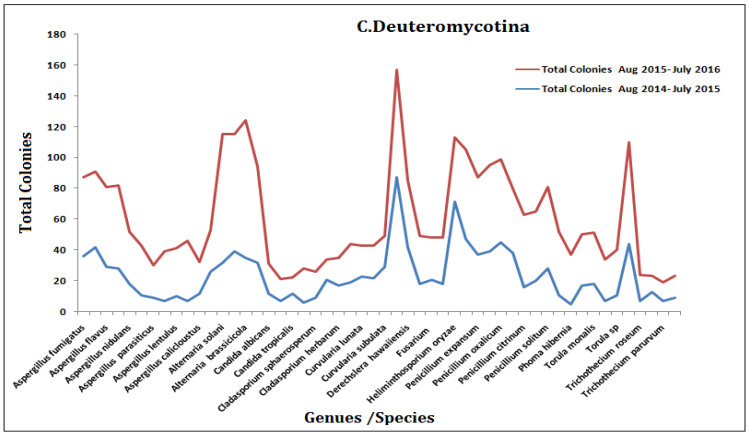

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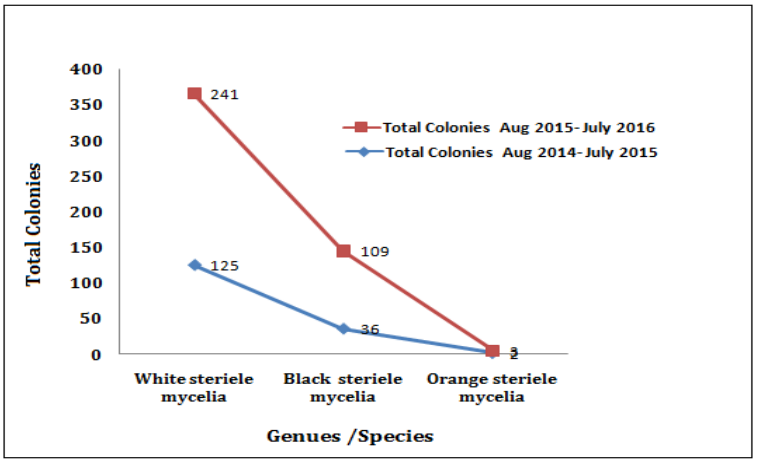

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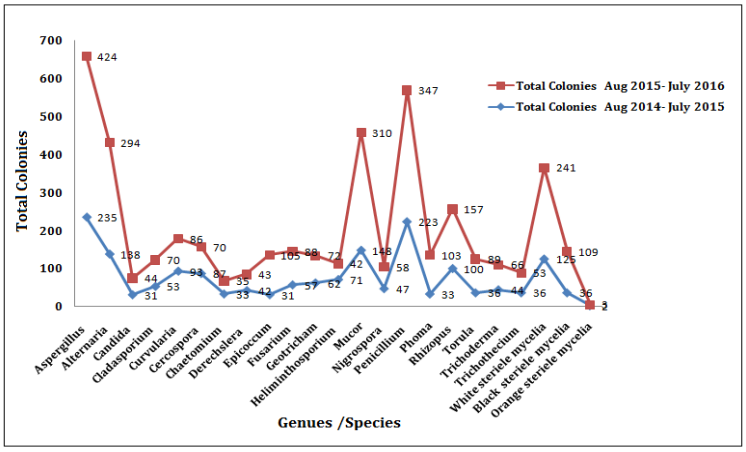

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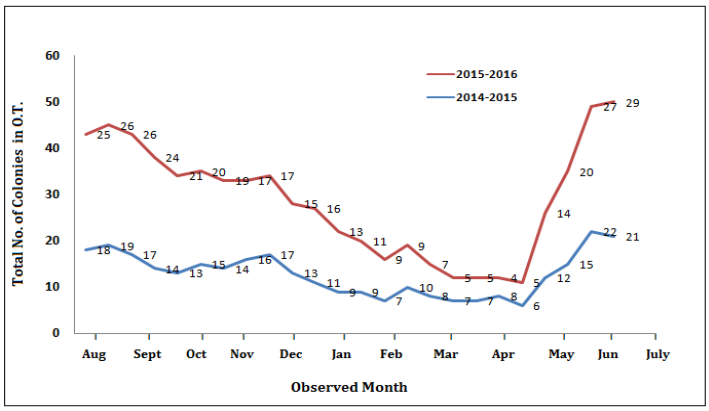

Fig. Total No of Fungal Colonies & Their Percentage Contribution in O.T. for 2014-2015 and 2015-2016

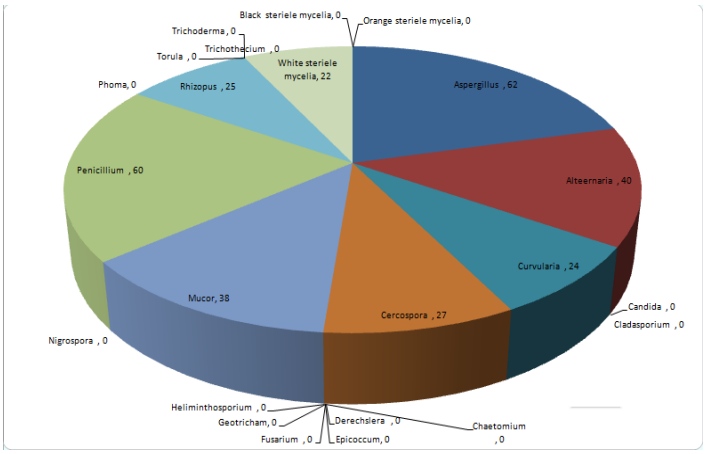

Fig. Total No of Fungal Colonies in O.T. Sections & % Contribution to Total Aeromycoflora in 2014-2015

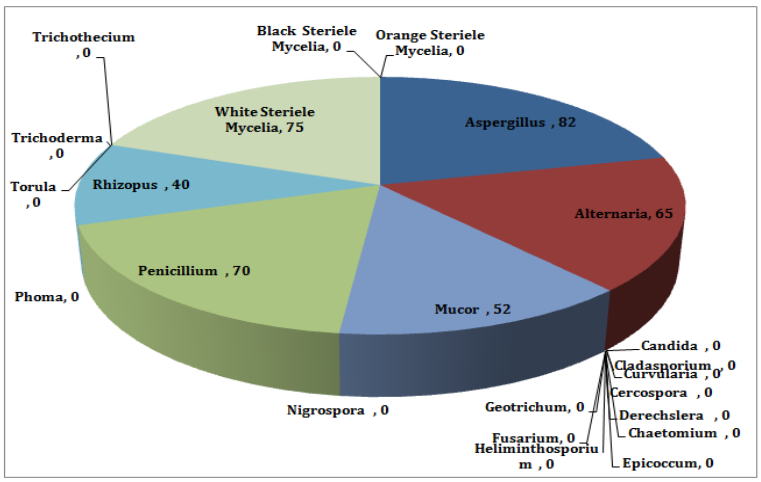

Fig. Total No of Fungal Colonies in O.T.
Sections & % Contribution to Total Aeromycoflora for 2015-2016

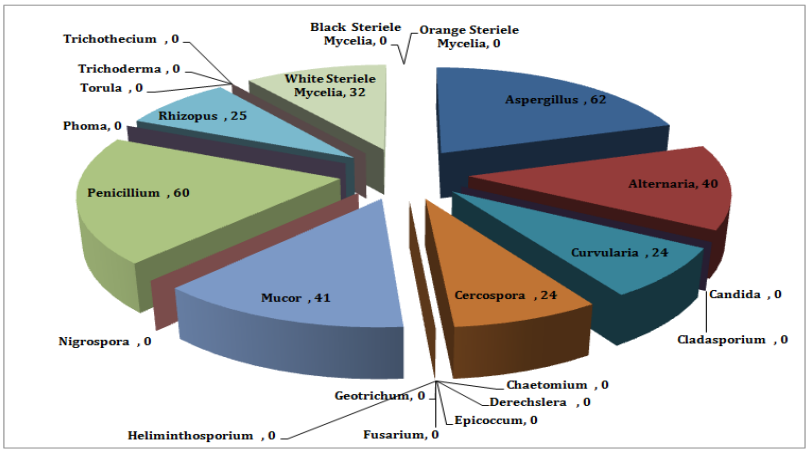

Fig.Total No of Fungal Colonies recorded in O.T.
& their % contribution of total aeromycoflora for 2014-2015

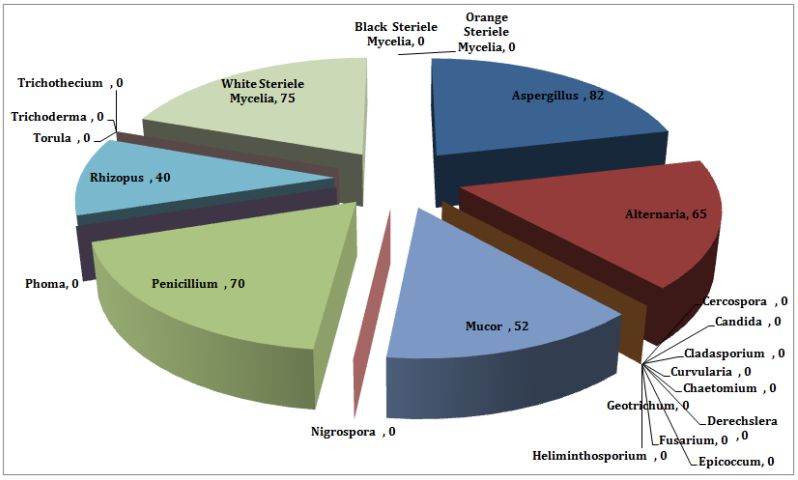

Fig. Total No of Fungal Colonies recorded in O.T.
& their % contribution of total aeromycoflora for the year 2015-2016

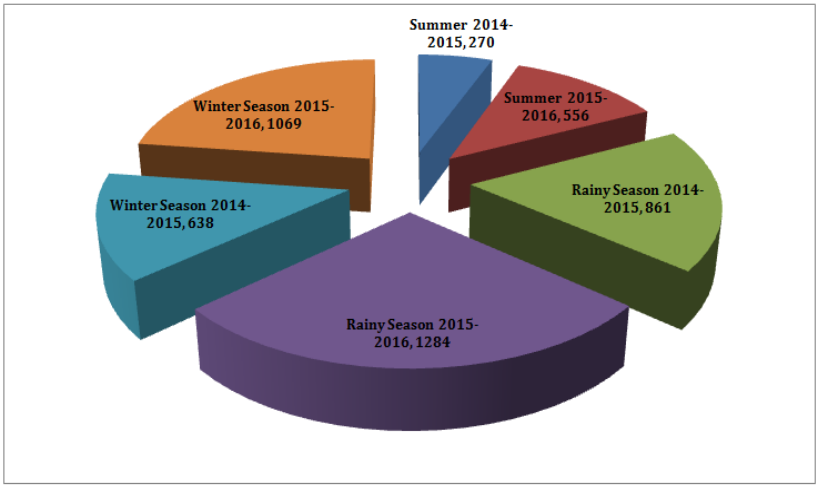

Fig. Seasonal Variations of C.F.U./M³ and no of colonies and their % Contribution of Total Aeromycoflora by Volumentric air sampler method for the year 2014-2015 & 2015-2016

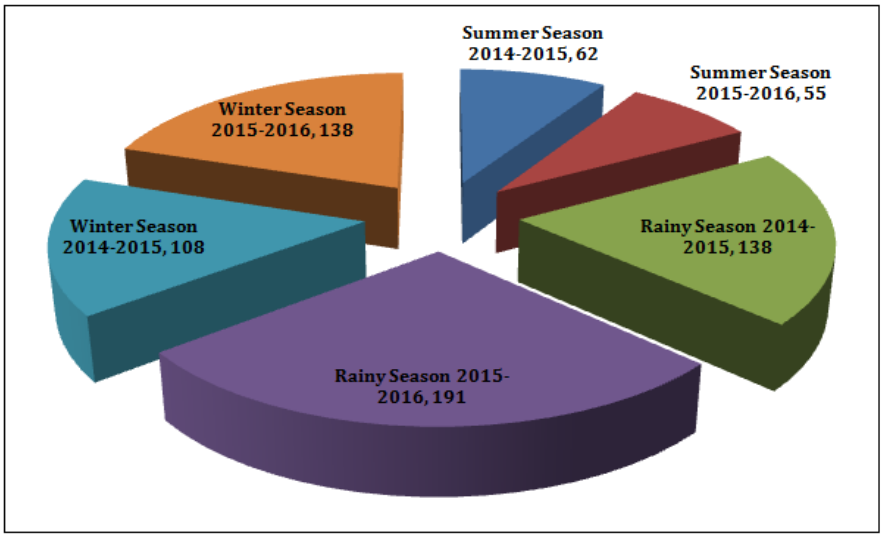

Fig. Seasonal Variations of C.F.U./M³ and Percentage Contribution in OT by Volumetric air sampler method in year 2014-2015 & 2015-2016

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