Fungal diversity, their concentration and impact over Jowar crop at Pune, India

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ABSTRACT

To study fungal diversity over Jowar crop, aerobiological investigations were carried out for four consecutive seasons. Tilak volumetric air sampler was used to estimate fungal diversity both qualitative and quantitatively with respect to meteorological parameters. Tilak air sampler runs on an electric supply and provides a continuous sampling for eight days. The spore analysis and identification was based on morphological characters, visual identification by comparison with reference slides, prepared from fungal collection in and around the crop fields by exposing culture plates. The meteorological parameters were recorded throughout the period of investigation. They exhibited great deal of variation during November 2009 to October 2010. In the census 63 fungal spore types have been identified upto generic level, other types are like hyphal fragments, pollen, protozoan cyst, insect parts. Analysis of fungal diversity after air sampling revealed 63 spore types including 34 from Deuteromycotina, 18 from Ascomycotina, 4 from Basidiomycotina and 2 from Phycomycotina. Percentage contribution of these fungal spore groups to the total airspora revealed that Deuteromycotina (60.19%) as a dominant group followed by Ascomycotina (13.25%), Basidiomycotina (21.35%), other types (2.5%), Phycomycotina (0.54%) and other types (2.96%). Average percentage contribution of each spore types to the total airspora revealed that *Cladosporium* (15%) as a dominant type followed by *Curvularia* (7.5%) *Alternaria* (7%), smut spore (6%) and *Cercospora* (5%). These spores have been observed throughout the investigations followed by respective disease incidence.

Keywords: fungal spores, meteorological parameters, Tilak air sampler

INTRODUCTION

Diversity in the airomicroflora includes fungal spores, pollen grains, protozoan, insect parts, trichomes. The pollen grains and fungal spores are of immense importance in inciting the health disorders in human beings and plants. The fungal spores present in the atmosphere are responsible to cause various diseases over many important crops including Jowar leading to severe crop loss, which affect the economy of farmers. According to Jacobs [2] aerobiology includes the dispersion of insect population, fungal spores, pollen, bacteria, viruses infact all microbial life forms belonging to both plants and animal group that are borne high up and transported partly or wholly in the atmosphere.

Cunningham [1], for the first time, investigated micro-organisms in air over presidency jail at Kolkata in India. Mehta's [4] work is noteworthy who had tackled the problems of rust of wheat and barley with aeroscope experiment at Agra. This study was carried out for two consecutive years, i.e. two rabi and two kharif seasons (2009 to 2011). The findings revealed seasonal variation in the percentage contribution during four seasons to the total aerospora. These studies over microenvironment of the Jowar crop revealed 58 fungal spore types and five other types.

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Phycomycotina was represented by *Cunninghamella* metr. and *Rhizopus* Ehrenb, while Ascomycotina was represented by 18 different ascospores. Basidiomycotina was represented by four spore types while Deuteromycotina was represented by highest number of spore types. Other types includes hyphal fragments, insect parts, pollen, protozoan cyst and unidentified spore types. Deuteromycotina dominated the aeropsora exhibiting 60.19% contribution to the total airspora may be due to accessory method of asexual reproduction and formation of exogenous spores leading high fecundity. It is followed by Basidiomycotina (21.35%), Ascomycotina (13.25%), other types 2.96% and Phycomycotina 0.54%.

Some of the fungal spore types were pathogenic to the Jowar crop. *Cladosporium*, *Curvularia, Alternaria,* Smut, Rust, *Helminthosporium, Cercospora* and *Nigrospora* were the dominant spore types in the aerospora over Jowar crop at Pune Maharashtra. Rust spores, Smut spores, *Claviceps, Helminthosporium, Ascochyta, Curvularia* were found to be pathogenic spore types causing diseases to the Jowar crop. The various ascospores were found to be released and encountered in the atmosphere over Jowar crop after the rainfall during the kharif seasons.

MATERIALS AND METHODS

Material is the atmospheric biocomponents over the environment at Pune, Maharashtra. Air sampling was carried out using continuous volumetric "Tilak air sampler" for November 2009-October 2010. Tilak air sampler [5] was kept at a constant height of 1.5m above the ground level, sampling the air at the rate of 5 L/min which deposites the airspora over the cellophane tape, fixed over the drum by impingment process. Cellophane tape loaded airspora have been replaced weekly. It is cut into 16 equal parts and mounted over the clean glass slides in melted glycerine jelly. Slides have been scaned under 45X × 10X combination of binocular research microscope for qualitative and quantitative estimation of airspora. Data of meteorogical parameters have been daily recorded for its relevance on spore incidence.

RESULTS AND DISCUSSION

These observations of dominant ascospores were studied during November, December, January and February 2009-2010. Out of seven dominant ascospores, *Claviceps* found to be most dominant among all having 7.05% contribution to the total airspora. *Leptospharia* (1.00%) in February, *Lophiostoma* (1.00%) in January and *Pleospora* (1.00%) in February found to be lowest percentage of contribution. There was no trace of *Lophiostoma* during February 2010 (Figure 1 and 2). Since the months of July, August, September and October 2009 were rainy seasons, the rainfall was good during July to October 2010. Percentage contribution of dominant ascospores were found to be dominant to the total airspora. *Claviceps* was found most dominant during august (16.15%). *Melanospora* was showing less concentration during the month of October (2.00%). 34 outdoor air samples were analyzed During a Rainy Season in Florida, USA [6]. The most abundant spore types present both indoors and outdoors were generally *Penicillium, Aspergillus* group, ascospores, basidiospores, *Cladosporium* species, spores classified in the Smuts, *Periconia*, Myxomycetes group, and *Curvularia* species.

Hysterium was showing moderate percentage contribution throughout the July to October 2010 (Figure 3). Deuteromycotina was found to be most dominant of all group of fungi. Among all the spores of Deuteromycotina, *Aletrnaria* was most dominant having percentage contribution, i.e. 20.15% to the total airspora. Various studies that identify types and levels of airborne fungal spores in buildings have been performed, the majority of them focus on problem with fungal growth, moisture problems, or health complaints from building occupants [7-10]. In this study, the most prevalent spore types detected ascospores, basidiospores, and *Cladosporium* species. These findings

are qualitatively similar to those observed in other geographical locations [11-16], confirming the ubiquitous nature of these fungi.

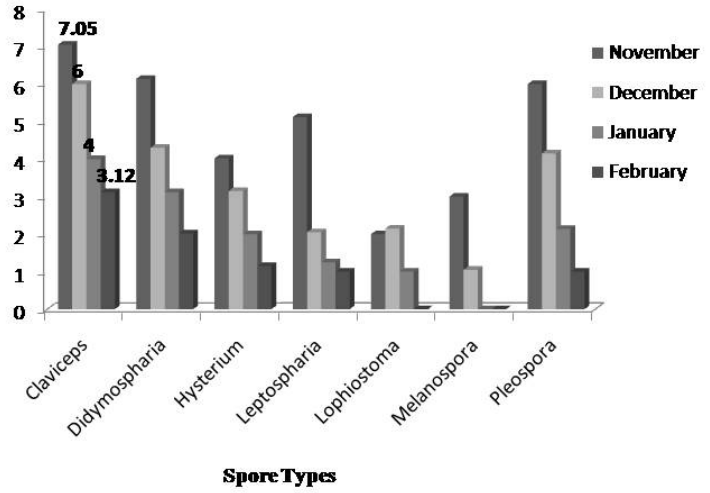

Figure 1. Monthly average percentage contribution of some dominant spore types of Deuteromycotina during July to Oct. 2010.

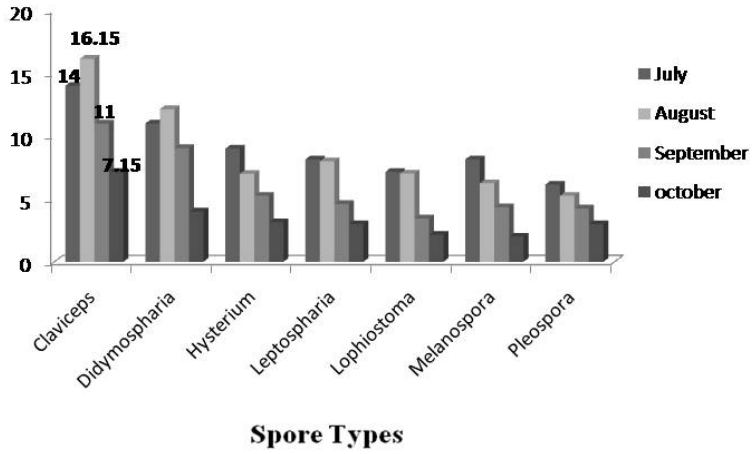

Figure 2. Monthly average percentage contribution of dominant ascospores to the total aerospora during July to Oct. 2009-2010.

Jogdand and Ingole found *Cladosporium* (13.55%) during their studies in 2013 [3].These results coincide with our findings. The effect of environmental parameters on aerospora during Nov 2009 revealed increase in the concentration of Deuteromycotina spores where the average temperature 21°C and relative humidity 66% (Figure 4). In present study *Cladosporium* (34.00%) was found to be dominant among all the months of Rabi as well as kharif seasons. Rainfall was moderate during the months of July and August 2009 and the humidity was around 80% during July and August 2009. *Helmonthosporium* (9.25%) and *Cercospora* (9.00%) were showing around similar percentage contribution during October 2009, but *Nigrospora* was the lowest during October 2009. Deuteromycotina spores were dominant during the month of August, where the rainfall,

humidity and temperature were found to be congenial for the growth and development of the fungal spores (Figure 5). Fungal spore trap analyses currently are being marketed to the medical and environmental industries as a means of evaluating fungal bioaerosols. Data revealed that only 75% of the accredited laboratories consistently identify *Cladosporium*, the most common mold in the environment [17].

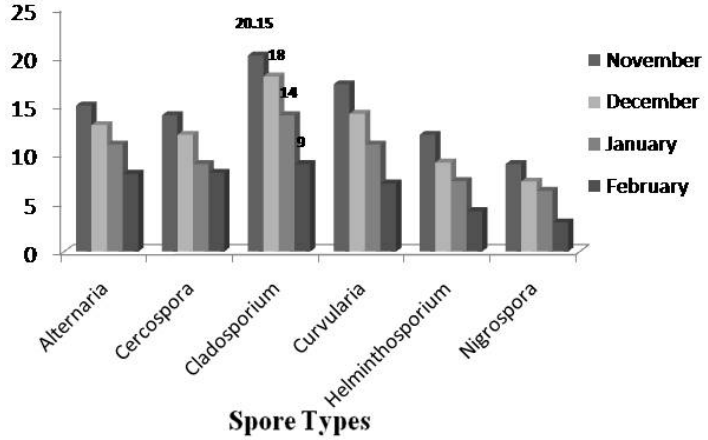

Figure 3. Monthly average percentage contribution of dominant ascospores during 2009-2010.

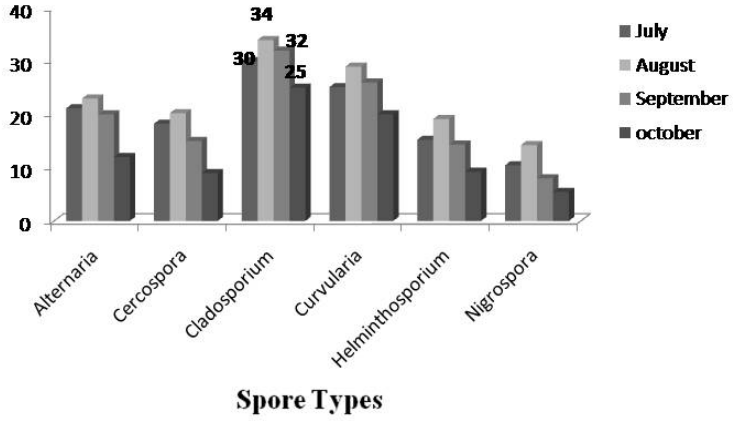

Figure 4. Monthly average percentage contribution of some dominant spore types of Deuteromycotina during 2009-2010.

Findings revealed 56 types of airbiocomponents causing, biopollution, biodeterioration, plant diseases as well as animal diseases. Some of the microbes were leading to allergic manifestations. Ascospores were dominant during rainy season mostly in the month of July and August 2009. *Lophiostoma* and *Melanospora* were absent in the month of February. During July to October months rainfall was good and the humidity was around 85%. These conditions were congenial for the growth of Ascospores and Deuteromycotina spores and showing higher percentage contribution during July to October 2010. Hence the qualitative and quantitative data is significant and definitely help to study plant and animal diseases in future.

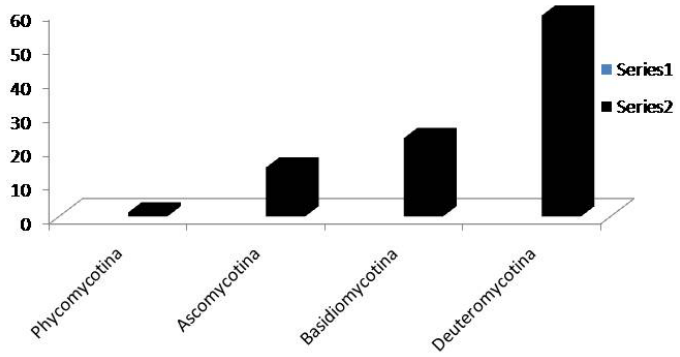

Figure 5. Groupwise average percentage contribution to the total airspora during 2009.

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