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Original Research Paper

Aeromycological Investigations in the Ambient Air Over Some Crop Fields in Context to Pathogenic and Allergenic Fungal Bioaerosols

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ABSTRACT

Aeromycological investigations were conducted with the help of continuous volumetric Tilak air sampler over jowar, wheat and groundnut fields which gave continuous air sampling for fungal bioaerosols for three consecutive Rabi seasons. Altogether 46 bioaerosols were trapped in the sampler over jowar fields of which 20 types (74.4%) were pathogenic and 25 types (81.5%) were allergenic in nature. Similarly 50 bioaerosols were recorded over wheat fields of which 21 types (71.7%) were pathogenic and 25 types (85.8%) were allergenic. In the atmosphere over groundnut fields 47 bioaerosols were recorded of which 21 types (71.6%) were pathogenic and 26 types (81.9%) were allergenic in nature. From these three different crop fields total 30 types of bioaerosols were recorded of which 27 belonged to fungal spore types while remaining three types belonged to other types. Though more bioaerosols were encountered, but this paper reports only pathogenic and allergenic bioaerosols.

INTRODUCTION

There is an increasing concern about the exposure of fungal bioaerosols in the environment that results in allergy and allergic disorders. The importance of fungal aeroallergens in pathogenesis of allergic diseases are known since earliest days of allergology. Pathogenic fungal bioaerosols are responsible to cause severe plant diseases to crop plants and they reduce crop yield. People often suffer from various respiratory allergic ailments (Shivpuri 1982, Mandal 1985). Increased awareness of environmental biopollution has led to the monitoring and studying the aspects of biopollution both at national and international levels. Health problems like allergy, asthma, pulmosis, rhinitis, pulmonary disorders, eczema and skin diseases prove the importance of study of bioaerosols.

Pathogenic and allergenic bioaerosols constitute major portion of airspora which includes plant debris, hyphal fragments, insects scales, fungal spores and pollen grains which cause devastating effects on human health and agriculture (Agarwal & Shivpuri 1974). It is well known fact that bioaerosols play role in etiology of bronchial allergy and asthma, very little work has been done in this area. Incidence of various plant diseases and allergic disorders has drawn considerable attention in recent days (Aberg 1989, Singh & Singh 1994). Hence, an attempt has been made to investigate concentration of bioaerosols and its relevance to allergic disorders for the first time from this unexplored area. This paper reports the concentration of pathogenic and allergenic bioaerosols in the ambient air environment over jowar, wheat and groundnut fields.

MATERIALS AND METHODS

Aeromycological investigations were carried out by operating continuous volumetric Tilak air sampler (Tilak & Kulkarni 1970) located in the middle of two acre field crops and kept at a constant height of 3 feet above the ground level during 3 consecutive Rabi seasons (Jowar field : November 2007 to March 2008, Wheat field : November 2008 to March 2009 and Groundnut field: November 2009 to February 2010). The spore number trapped in the sampler was expressed as number of spores per cubic meter of air. Prepared slides were scanned using research binocular microscope for estimating the concentration number and percentage contribution. Identification of fungal bioaerosols was based mainly on comparative spore morphology and spore description.

The spore number of bioaerosols was calculated for specific count by multiplying the actual number of spores encountered with the conversion factor of sampler which is 14. The spores which could not be identified due to their obscure nature or even otherwise were placed under unidentified type. Spore types were identified up to generic level with the help of relevant literature (Tilak 1989).

RESULTS AND DISCUSSION

During the period of present investigation over jowar fields 46 bioaerosols were recorded of which 41 belonged to fun-

gal origin while remaining 5 belonged to other types. Out of 41 types 2 belonged to Mastigomycotina (1.2%), 1 to Zygomycotina (0.8%), 9 to Ascomycotina (7.7%), 3 to Basidiomycotina (12.4%) and 26 to Deuteromycotina (68.4%). Other types contributed 9.5%. Among these bioaerosols, 20 types (74.4%) were pathogenic and 25 types (86.5%) were allergenic in nature and from these 17 types (69.9%) were both pathogenic and allergenic. The total airspora contributed 115248/m^3 of air of which pathogenic and allergenic types contributed 104943/m^3 of air (Table 1).

Environmental monitoring over wheat field contributed 50 types of which 45 belonged to fungal origin, while 5 belonged to other types (15.8%). Out of 50 types of bioaerosols 2 belonged to Mastigomycotina (1.2%), 2 to Zygomycotina (3.3%), 11 to Ascomycotina (7.9%), 3 to Basidiomycotina (11.3%), and 27 to Deuteromycotina (60.5%). From these 21 types (71.7%) were pathogenic, 25 types (85.8%) were allergenic and 17 types (68.6%) were both pathogenic and allergenic. Total spore concentration was 131712/m^3 of air of which pathogenic and allergenic types contributed 117096/m^3 of air.

Analysis of various bioaerosols revealed 47 types over groundnut field which contributed 134848/m^3 of air of which 120652/m^3 of air were pathogenic and allergenic (89.4%). From 47 types, 42 types belonged to fungal spore origin of which 2 belonged to Mastigomycotina (1.6%), 2 to Zygomycotina (2,1%), 7 to Ascomycotina (6.5%), 3 to Basidiomycotina (10.8%) and 28 to Deuteromycotina (64.3%), Other types were 5 (14.7%). Among these bioaerosols 21 types (71.6%) were pathogenic, 26 types (81.9%) were allergenic and 17 types (65.8%) were both pathogenic and allergenic in nature. These results confirm with the reports of Sharma & Sinha (1973), Reddi (1978), Joshi (1975), Eversmeyer & Kramer (1987), Mallaiah & Rao (1980) and Murdhankar & Pande (1991).

During the present investigations over 3 different crop fields total 30 types of bioaerosols were recorded of which 27 belonged to fungal spore type origin, while 3 belonged to other types *viz.* hyphal fragments, pollen grains and insect (scales) parts. These 3 types are well known aeroallergens responsible for nasobronchial allergy, respiratory allergy and cause allergenic reactions (Nair 1978, Kulkarni 1981, Shivpuri 1980). This study clearly points out the prevalence of large percentage of aeroallergens which may be responsible for inducing allergenic reactions to sensitive individuals.

Clinical investigations carried out at Aurangabad clearly indicate the significant allergenic nature of *Rhizopus*, *Chaetomium, Pleospora, Alternaria*, Aspergilli, *Cladosporium, Curvularia, Epicoccum, Cercospora, Nigrospora, Helminthosporium, Humicola, Heterosporium* and hyphal fragments (Tilak 1989). In India important allergenic fungi in order of their frequency and allergenic significance are *Curvularia*, *Alternaria*, *Helminthosporium, Cladosporium, Aspergillus* and *Rhizopus* (Shivpuri 1982).

Cladosporium as an allergen was at the top in concentration and percentage contribution. Agarwal & Shivpuri (1974) reported role of *Cladosporium* bioaerosols in etiology of respiratory allergic disorders. *Alternaria, Curvularia, Periconia, Helminthosporium* and *Nigrospora* are known to be potentially allergenic (Tilak 1989). Allergenic diseases due to aspergilli and penicilli are recorded by Singh & Singh (1994). *Epicoccum* and *Pithomyces* may cause allergic reactions (Shenoi & Ramalingam 1976). Allergenic bioaerosols of *Stemphylium, Fusarium, Trichothecium* and *Heterosporium* were recorded with low concentration which correlates with the reports of Agarwal & Shivpuri (1974), Karne & Pande (2006) and Karne (2008).

Rhizopus and *Mucor* may cause rhinitis and asthma when inhaled by sensitive individuals. It may cause respiratory symptoms and airway diseases (Singh & Singh 1994). Bioaerosols of *Chaetomium, Pleospora* and *Leptosphaeria* are reported to cause allergy and acute asthma by Frankland & Gregory (1953). Smut spores, Rust spores and Basidiospoers as allergens were reported by Cadham (1924) in North America in causing asthma. Exposure to aeroallergens in environment may cause mycoses and allergenic disorders (Mandal 1985). Fungal bioaerosols were encountered more or less throughout the study period.

Fungal bioaerosol and pollen grain allergy is a clinical disorder affecting the human health in India and other countries appears to be one of the common most major health problem and cause allergenic reactions (Shivpuri 1982).

In recent years several plant diseases have become severe in agricultural crops. Intensive cultivation of crop plants by farmers throughout year as a result, host plants for several plant pathogens like *Alternaria, Puccinia, Cercospora, Helminthosporium, Colletotrichum*, smut spores, *Diplodia, Sclerospora, Stemphylium, Fusarium* etc. are recorded almost all round the year. When the weather conditions favour the appearance of diseases in many places, the large stretches of crop plants are destroyed (Karne 2011).

Several epiphytotics of plant diseases have occurred due to favourable meteorological conditions. These studies in relation to allergy and phytopathology will bringforth many useful and meaningful results for implementing cheaper and better preventive measures of crop plant disease management and disease forecasting models. The study of bioaerosols and its effect is of great significance to allergenic disorders and health hazards in human beings as well

Table 1: Allergenic and pathogenic fungal bioaerosols with concentration (spores/m^3 of air) and percentage contribution to the total airspora.

Sr. No.	Spore type	Jowar Field		WheatField		Groundnut Field	
		Spore Concentration	Percentage Contribution	Spore Concentration	Percentage Contribution	Spore Concentration	Percentage Contribution
1	*Cladosporium*+*	31695	27.5	31486	23.9	37940	28.1
2	*Alternaria*+*	7140	6.2	7770	5.9	6874	5.1
3	Rust spores+*	7140	6.2	7770	5.9	6062	4.5
4	*Nigrospora**	4844	4.2	4074	3.1	3640	2.7
5	*Cercospora*+*	4746	4.1	5012	3.8	8358	6.2
6	Smut spores+*	4746	4.1	5670	4.3	5264	3.9
7	*Drechslera*+*	4032	3.5	3164	2.4	2170	1.6
8	*Helminthosporium*+*	4032	3.5	4214	3.2	2968	2.2
9	*Curvularia*+*	3682	3.2	4872	3.7	3920	2.9
10	*Periconia**	3682	3.2	4214	3.2	2828	2.1
11	Hyphal fragments+*	2758	2.4	7112	5.4	4984	3.7
12	Aspergilli+ Penicilli+*	2534	2.2	4088	3.1	5670	4.2
13	Basidiospores+*	2408	2.1	1456	1.1	3234	2.4
14	*Leptosphaeria*+*	2408	2.1	2898	2.2	3696	2.7
15	Pollen grains*	2408	2.1	4998	3.8	4592	3.4
16	*Chaetomium**	2072	1.8	1974	1.5	2170	1.6
17	*Colletotrichum*+	2072	1.8	2506	1.9	2828	2.1
18	*Diplodia*+	2072	1.8	406	0.3	938	0.7
19	*Epicoccum**	1960	1.7	658	0.5	1078	0.8
20	*Pleospora**	1834	1.6	2366	1.8	1358	1.1
21	*Heterosporium*+*	1386	1.2	406	0.3	420	0.3
22	*Pithomyces**	1386	1.2	1582	1.2	1890	1.4
23	*Sclerospora* (oospores)+	1036	0.9	1036	0.8	952	0.7
24	*Mucor*+ *Rhizopus*+*	980	0.8	3150	2.4	1750	1.3
25	Insect scales (parts)*	980	0.8	2758	2.1	2968	2.2
26	*Stemphylium*+*	574	0.5	518	0.4	420	0.3
27	*Fusarium*+*	224	0.2	532	0.4	700	0.5
28	*Trichothecium*+*	112	0.1	266	0.2	420	0.3
29	*Trichoconis*+	-	-	140	0.1	280	0.2
30	*Humicola**	-	-	-	-	280	0.2
	Total	**104943**	**91.0**	**117096**	**88.9**	**120652**	**89.4**
	Total Airspora	115248	100	131712	100	134848	100

Note : + = Pathogenic * = Allergenic

as in plant pathology. Study of this aspect is highly interdisciplinary and has tremendous scope to find the significant application to agriculture and human health. Environmental monitoring data obtained may be used for practical disease management by forewarning farmers about the attack of plant diseases. Plant pathogenic fungi are known to produce very large number of bioaerosols from infected tissues (Shenoi & Ramalingam 1976, Tilak 1998, Khandelwal 2002, Karne 2012).

REFERENCES

Aberg, N. 1989. Asthma and allergic rhinitis in Swedish Conscripts. Clin. Exp. Allergy, 19: 59-53.

Agarwal, M.K. and Shivpuri, D.N. 1974. Fungal spores, their role in respiratory allergy. Adv. Pollen Res., 1: 78-128.

Cadham, F.T. 1924. Asthma due to grains rust. J. Am. Med. Soc., 83: 27.

Eversmeyer, M.G. and Kramer, C.L. 1987. Vertical concentration of fungal spores above wheat fields. Grana, 26(1): 97-102.

Frankland, A.M. and Gregory, P.H. 1953. Allergenic and agricultural implementation of airbrone asospore concentration. Nature, 245: 336-337.

Joshi, L.M. 1975. Recent contribution towards epidemiology of wheat rusts in India. Phytopath., 29: 1-15.

Karne, A.V. and Pande, B.N. 2006. Aeromycological study of allergenic fungal aerobiopollutants over potato fields. Poll. Res., 25(3): 525-530.

Karne, A. V. 2008. Aerobiological investigation of allergenic fungal aerobio-pollutants and its relevance in public health. The Ecoscan, 2(1): 95-98.

Karne, A.V. 2011. An investigation of fungal aerobiopollutants in the ambient air over maize fields. Nat. Env. Poll. Tech., 10(4): 609-612.

Karne, A.V. 2012. A report on incidence of allergenic and pathogenic fungal aerobiopollutants and its relevance to agriculture and public health at Khatav (M. S.). Int. J. Env. Sci., 3(1): 91-97.

Khandelwal, A. 2002. Long term monitoring of airborne pollen and fungal spores and their allergenic significance. Palaeobotanist, 51: 153-159.

Kulkarni, R.L. 1981. Atmospheric concentration of hyphal fragments. Proc. Nat. Conf. Env. Bio., pp. 209-214.

Mallaiah, K.V. and Rao, A.S. 1980. Airspora of groundnut fields. Ind. Aca. Pl. Sci., 89: 269-281.

Mandal, S. 1985. Aeroallergens of West Bengal with reference to respiratory allergy. Ann. Allergy, 55: 38-385.

Murdhankar, S.V. and Pande, B.N. 1991. Aerobiology and epidemiological approach to groundnut rust. Ind. J. Aerobiol., 4: 19-22.

Nair, P.K.K. 1978. Pollen-problems and promises. Science Reporter, 15: 378-388.

Reddi, C.S. 1978. Vertical profile of spore concentration within and above a jowar crop. Phytopath., 93: 35-40.

Sharma, J.K. and Sinha, S. 1973. Spore content of air over *Sorghum* field near Agra. Ind. Sorghum News letter, 16: 96-99.

Shenoi, M.M. and Ramalingam, A. 1976. Airspora of *Sorghum* fields at Mysore. J. Palynol., 12: 43-54.

Shivpuri. D.N. 1980. Clinically important pollen, fungal and insect allergens for nasobronchial allergy patients in India. Asp. Allergy Appl. Immunol., 13: 19-23.

Shivpuri, D.N. 1982. Studies in allergy to fungi in India. Asp. Allergy Appl. Immunol., 15: 19-30.

Singh, A and Singh, A.B. 1994. Airborne fungi in bakery and prevalence of respiratory dysfunction among workers. Grana, 33: 349-358.

Tilak, S. T. 1989. Airborne Pollen and Fungal Spores. Vaijayanti Prakashan, Aurangabad, pp. 316.

Tilak, S. T. and Kulkarni R. L. 1970. A new air sampler. Experientia, 26: 443-444.