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Original Research Paper

Incidence of Airborne Biocomponents in Context to Meteorological Parameters Over Some Crop Fields

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ABSTRACT

The present investigation was undertaken to understand the incidence of various biocomponents over jowar (*Sorghum vulgare*) field, wheat field, groundnut field and maize field. Environmental monitoring was carried out by operating continuous volumetric Tilak Air Sampler for 4 consecutive Rabi seasons, for the first time in this unexplored locality. Apart from dust particles and fungal bio-aerosols, remaining 5 biocomponents are reported in this paper which belonged to the group 'Other types', comprising of hypha fragments, insect scales (parts), pollen grains, trichomes (hairs) and unidentified fungal spores. From the various crop fields studied, these bio components contributed highest (15.8%) over wheat field and lowest (9.4%) over maize field to the total airspora. Airborne biocomponents obtained peak in the month of November over wheat field (17.8%) and groundnut field (16.6%), when there was a record of 22.5°C and 21.8°C mean temperature, 54.4% and 56.7% mean relative humidity and 10.4 mm and 14.5 mm rainfall respectively. Similar peak was obtained in the air over jowar field (11.6%) and maize field (11.3%) in the month of March, when there was a record of 30.6°C and 30.1°C mean temperature, 42.4% and 42.2% mean relative humidity and nil record of rainfall. Allergenic nature of hyphal fragments, insect scales and pollen grains causing allergy and allergenic ailments in human health hazards is also presented in this paper.

INTRODUCTION

India is an agricultural country with the majority of population depending on agriculture sector directly or indirectly. Agriculture continues to be the mainstay of the Indian economy. Jowar (*Sorghum vulgare* (L.) Moench.) is the most important food and fodder crop. In terms of production, wheat (*Triticum aestivum* Linn.) occupies the prime position among food crops in the world. In India, it is the second most important food crop being next to rice and contributes to the total food grain production of the country. Among the major oilseed crops, groundnut or peanut (*Arachis hypogaea* Linn.) is cultivated by many farmers as a source of oil, seed, oil cake and fodder for cattle. Maize (*Zea mays* Linn.) is a staple food crop, it is cultivated by many farmers as a source of food for man, fodder for animals and it is also used in the cattle and poultry feed industries.

These crops are subjected to various diseases caused by fungi, bacteria and viruses. Among these are the fungal diseases which cause severe losses, reduce yield and production of crops. Therefore, environmental monitoring was carried out over these crop fields to find out chief biocomponents based on qualitative and quantitative analysis. The incidence of biocomponents over these crop fields and effect of meteorological parameters is presented in this paper. Pathogenic and allergenic nature of biocomponents are also recorded during the study period.

MATERIALS AND METHODS

The aerobiological investigations have been carried out with the help of continuous volumetric Tilak Air Sampler (Tilak & Kulkarni 1970) located in the middle of the test field crops at a height of 3 feet above the ground level. The studies were conducted during consecutive Rabi seasons over jowar field (November 2007 to March 2008), wheat field (November 2008 to March 2009), groundnut field (November 2009 to February 2010) and maize field (December 2010 to March 2011). Environmental monitoring was initiated 8 days prior to the sowing of the crop fields and continued for 8 days after the harvesting of the same crops. The study site was completely exposed on all sides, having a free display of air currents in all directions.

Slides were scanned for estimating the total number of biocomponents and their percentage contribution. The identification was based on the comparative morphology, description and microscopic characters. The biocomponents trapped in the sampler were expressed in meter cube of air. During the period of the present investigation, daily records of temperature, relative humidity and rainfall were maintained throughout the study period.

Table 1: Concentration and percentage contribution of airborne biocomponents to the total airspora during Rabi seasons over crop fields.

Sr. No.	Biocomponent	Jowar Field		Wheat Field		Groundnut Field		Maize Field	
		Spore concentration (m^3)	Percentage contribution	Spore concentration (m^3)	Percentage contribution	Spore concentration (m^3)	Percentage contribution	Spore concentration (m^3)	Percentage contribution
1	Hyphal fragments+*	2758	2.4	7112	5.4	4984	3.7	2198	2.8
2	Insect scales (parts)*	980	0.8	2758	2.1	2968	2.2	560	0.7
3	Pollen grains*	2408	2.1	4998	3.8	4592	3.4	1876	2.4
4	Trichomes (hairs)	1960	1.7	2226	1.7	2422	1.8	938	1.2
5	Unidentified spores	2870	2.5	3682	2.8	4888	3.6	1806	2.3
	Total	**10976**	**9.5**	**20776**	**15.8**	**19824**	**14.7**	**7378**	**9.4**
	Total airspora	**115248**	**100**	**131712**	**100**	**134848**	**100**	**78596**	**100**

Note: + = Pathogenic, * = Allergenic

RESULTS AND DISCUSSION

The 5 biocomponents trapped during the study period, belonging to group 'Other types' comprised of hyphal fragments, insect scales (parts), pollen grains, trichomes (hairs) and unidentified spores. This unusual and artificially formed group is reported in this paper. Hyphal fragments when retain their viability, they act like spores and are common in the air. They may be short, long, simple, branched, coloured or dark and hyaline and were trapped throughout the study period. Their contribution to the total airspora was recorded over jowar field (2758/m^3, 2.4%), wheat field (7112/m^3, 5.4%), groundnut field (4984/m^3, 3.7%) and maize field (2198/m^3, 2.8%) (Table 1). The maximum monthly mean concentration over jowar field (952/m^3 in February), wheat field (1960/m^3 in February), groundnut field (1596/m^3 in February) and maize field (826/m^3 in the March) was recorded during the Rabi season. Mostly dematiaceous hyphae were encountered during the period of this investigation. The obtained results are in conformity with the observations made by Harvey (1970) and Tilak & Bhalke (1981). Hyphal fragments are much more important through the point of view of their viability (Pady & Kramer, 1960). Observations made and results obtained clearly indicate that meteorological factors had their direct or indirect influence on the concentration of hyphal fragments in the air. Hyphal fragments are getting importance as potential allergens in recent years.

In the present investigations, the insects scales (parts) also contributed significantly over the jowar field (980/m^3, 0.8%), wheat field (2758/m^3, 2.1%), groundnut field (2968/m^3, 2.2%) and over maize field (560/m^3, 0.7%). The maximum monthly mean concentration over jowar field was (336/m^3 in January), wheat field (840/m^3 in February), groundnut field (966/m^3 in January) and over maize field (210/m^3 in the month of February) was recorded during the consecutive Rabi seasons. Insect scales, insect parts like legs, bristles, hairs, wings and sometimes even complete small insects were encountered during the study period. Insect parts generally occur in open air after the death and while shedding wings and scales when they fly. High concentration of insect parts in the air was associated with a moderate relative humidity and high wind velocity. Shivpuri (1980) and Pande (2006) reported the role of insects and insect parts in causing allergy. Tilak & Bhalke (1979) reported seasonal, occasional and perennial allergenic disorders due to insect scales (parts).

All the various types of pollen grains trapped during the study period were placed under the group 'Pollen grains'. Their contribution to the total airspora was recorded over jowar field (2408/m^3, 2.1%), wheat field (4998/m^3, 3.8%), groundnut field (4592/m^3, 3.4%) and over maize field (1876/m^3, 2.4%). The maximum monthly mean concentration over jowar field (560/m^3 in January), wheat field (1232/m^3 in March), groundnut field (1610/m^3 in February) and maize field (686/m^3 in February) was recorded. Tilak & Bhasale (1983), Singh (1987) and Singh & Malik (1992) reported pollen grains in causing allergy and allergenic disorders in human beings. Pollen grains play an important role in nasobronchial allergy (Verma, 1995) and allergenic disorders (Boral et al. 2004) and Singh & Kumar, 2004). Allergologists, allergy specialists and medical practitioners are paying attention on allergy aspects in India as well as abroad.

Various types of trichomes like simple, unicellular, glandular, branched, filamentous and stellate were recorded. Trichomes (hairs) have been reported throughout the period of investigation. Contribution of trichomes to the total airspora over jowar fields was (1960/m^3, 1.7%), wheat field

Table 2: Comparative monthly data of temperature, relative humidity, rainfall and percentage contribution of biocomponents over crop fields.

Sr. No.	Crop fields and meteorological Parameters	November	December	January	February	March
1	**Jowar Field**					
a.	Temperature (°C)	21.5	20.7	22.4	24.2	30.6
b.	Relative humidity (%)	57.4	58.2	51.4	55.6	42.4
c.	Rainfall (mm)	-	4.8	3.5	4.5	-
d	Percentage contribution	9.8	8.7	8.1	9.6	11.6
2	**Wheat Field**					
a.	Temperature (°C)	22.5	19.4	20.4	22.6	31.2
b.	Relative humidity (%)	54.4	55.9	56.1	51.8	45.2
c.	Rainfall (mm)	10.4	-	5.5	3.5	-
d.	Percentage contribution	17.8	14.3	14.6	15.8	17.5
3	**Groundnut Field**					
a.	Temperature (°C)	21.8	20.4	19.8	24.6	-
b.	Relative humidity (%)	56.9	54.2	55.4	52.2	-
c.	Rainfall (mm)	14.5	2.9	-	5.8	-
d.	Percentage contribution	16.6	14.7	13.2	15.4	-
4	**Maize Field**					
a.	Temperature (°C)	-	19.9	20.2	21.3	30.1
b.	Relative humidity (%)	-	56.2	51.8	54.6	42.2
c.	Rainfall (mm)	-	-	4.2	4.6	-
d.	Percentage contribution	-	9.9	8.8	8.5	11.3

(2226/m^3, 1.8%), groundnut field (2422/m^3, 1.8%) and over maize field was (938/m^3, 1.2%). The maximum monthly mean concentration over jowar field was (518/m^3 in March), wheat field (616/m^3 in March), groundnut field (868/m^3 in February) and over maize field was (336/m^3 in March) recorded. The incidence of particulate matter like trichomes (hairs) was reported by Benninghoff (1965).

Apart from these different biocomponents, there were a number of unidentified spore types. All these were placed under an artificial group named as 'Unidentified spores'. It included one, two, three or many celled spore types. They were coloured or hyaline spores. As a matter of fact, owing to inadequate, distinct external features, some spore types which were many celled, rounded, elongated, elliptical and broken in appearance and infrequent in occurrence also consisted this group. Their contribution to the total airspora was recorded over jowar field (2870/m^3, 2.5%), wheat field (3682/m^3, 2.8%), groundnut field (4888/m^3, 3.6%) and over maize field (1806/m^3, 2.3%). The maximum monthly mean concentration over jowar field (868/m^3 in March), wheat field (538/m^3 in March), groundnut field (963/m^3 in February) and over maize field (658/m^3 in February) was recorded. Though these spores could not be identified to the generic level in the present investigation, their count was necessary to record and maintain the original total spectrum of the airspora over the studied crop fields. Similar observations were reported by Karne (2007).

It is well documented by earlier works that the exposure to outdoor biocomponents, increases the airway responsiveness to the aero-allergens and causes allergy (Shivpuri 1980, Tilak & Rao 1985, Karne & Pande 2006 and Karne, 2012). People working in agriculture fields often suffer from various allergic ailments like repeated cold, sneezing, agricultural asthma and breathlessness due to the fungal spores, pollen grains, insect parts and hyphal fragments, which affects the human health (Karne 2008 and Karne 2013). Airborne biocomponents obtain peak over jowar field in the month of March, when there was a record of 30.6°C mean temperature, 42.4% mean relative humidity and nil record of rainfall. Over wheat field it was during the month of November when there was a record of 22.5°C mean temperature, 54.4% mean relative humidity and 10.4 mm rainfall. In the air over groundnut field it was in the month of November when there was a record of 21.8°C mean temperature, 56.9% mean relative humidity and 14.5 mm rainfall. The same peak was recorded in the month of March over maize field when there was a record of 30.1°C mean temperature, 42.2% mean relative humidity and nil record of rainfall (Table 2).

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