

Study of the Diseases caused by the Airborne Fungal Spores

Dr. Nandini Kakati

HoD, Dept. of Botany

Abstract

Aerobiology has developed into an expanding science with inter disciplinary borders extending to plant pathology, mycology, palynology, biodeterioration and allergy. The aerobiological investigations of the outdoor atmosphere involve the experiments conducted for the detection of the aero allergenic fungal spores and other biologically significant particles which have their impact on human health as a part of the general aerobiological experiments. The airborne fungal spores such as *Aspergillus*, *Cladosporium*, *Stachybotrys* etc. play an important role in allergic disorders to man. Again many plant diseases are caused by some airborne fungi, such as *Alternaria*, *Fusarium*, *Helminthosporium*, *Cercospora*, *Pyricularia* etc.

Introduction

Aerobiology is a more recently developed multidisciplinary science dealing with aerial bioparticles present both in indoor and outdoor environments and their impacts on plants, animals and human system and also provide means for preventing or controlling airborne diseases. These bioparticles include pollen grains, fungal spores and some other microscopic particles. The study of aerobiology has its bearing on various areas of human health and welfare among which may be mentioned allergy and plant pathogenicity, involving fungal spores, which form the subject matter of the present investigation.

A disease is an abnormal condition that affects the body of an organism. It is often construed as a medical condition associated with specific symptoms and signs. It may be caused by factors originally from an external source, such as infectious diseases or it may be caused by internal dysfunctions, such as autoimmune diseases. There are four main types of diseases : pathogenic disease, deficiency disease, hereditary disease and physiological disease. Majority of the pathogenic disease of the organisms are caused by fungi, bacterial spores, virus etc. Within the group of

microorganisms fungi are dominant in the air followed by pollen, bacterial spores etc. Fungal spores are always present in the air although their number depends on time of day season, geographical location etc.

The investigation of aerobiology is important in the pathogenesis of respiratory allergic diseases in human beings. Allergic Bronchiopulmonary Aspergillosis (ABPA) is the most frequently recognised disease caused by the fungi *Aspergillus* sps. More than 15% of the human population suffer from allergic disorders such as rhinitis, conjunctivitis and atopic dermatitis etc. caused by airborne fungi.

Origin of Problems

History of aerobiology is also an enterprising aspects. In "Atharva Veda" and "Ayurveda" which dates back about 1000 B. C., it has been clearly suggested that inhalation of contaminated air causes respiratory diseases. One of the daily duties prescribed by "Aryan scripture" was the offering to fire knowledge as "Agnihotra". Agnihotra is performed daily in the morning and evening. The utility of "Agnihotra" as mentioned in ancient Indian literature was for the purification of air in the house and the surroundings. The ancient Indian literature clearly pointed out the modern concept of plant pathology and allergy. In the ancient literature like "Vedas" (1500-500 B. C.) from India, there are references of plant, animal and human diseases and various control measures.

In India, aerobiological investigations have been also carried out with reference to diseases of rice, wheat, jawar, bajra, sugarcane, cotton, banana, potato, citrus, sunflower, groundnut, mung, arhar and vegetables by various investigators.

Methodology

Aerobiological sampling methods are diverse based on different scientific principles and vary according to individual interest in component of the aeromicroflora. For air monitoring of the selected sites, the petriplate exposure method has been used. The identifications are based on the colour, size, shape of spores, symptoms of the diseases and other important diagnostic features. Literature consulted for fungal spore and disease identification are the books written by Nair et.al (1986) Tilak (1989) and Priti Kakati (2000).

Result

Fungal spores contribute a major portion of air-spora. The relevance of fungal spore content of the atmosphere is very important to the scientists engaged in various fields of research like (1) Plant Pathology - due to the presence of airborne plant pathogens (2) Medicine - Since some fungal spores act as allergens and (3) Industrial Microbiology - spores responsible for deterioration of stored food materials.

The result of investigations all over the world have established beyond doubt the significant role of fungal spores in the etiology of respiratory allergic disorders. More than 15% of human population suffer from allergic disorders such as rhinitis, conjunctivitis and atopic dermatitis etc. The incidence of occupational asthma accounts for 5-15% of all asthma. Since the time of Blackly (1873) it was known that certain forms of human allergy such as hay fever (seasonal allergic colds), asthma and sometimes eczema was associated with certain airborne spores. He noted that the inhalation of fungus spores (*Puccinia glaucum*) causes allergic effects. Freinberg (1947) has proved that not only *Puccinia* spp. but also *Alternaria*, *Cladosporium* and *Mucor* spp. which act as allergic reagents.

A fumigatus, an opportunistic infection has now surfaced as a pathogen found to effect the respiratory system leading to a disease called Allergic Bronchiopulmonary Aspergillosis (ABPA) with symptoms very similar to tuberculosis. *Aspergillus* spp. are responsible for causing ABPA. Apart from being allergenic, spores of some mould species such as *Stachybotrys* contain toxic. Compounds called mycotoxins. Symptoms associated with mould spores may include allergy, headache and fatigue, running nose, sneezing, coughing pneumonia and asthma among other non-specific symptoms. Young children, the elderly and people undergoing medical treatment are particularly susceptible to mould spores.

Few fungal diseases need to be focused immediately due to the emerging treat to public health. The diseases which are to be dealt immediately include aspergillosis, candidiasis, histoplasmosis, cryptococcosis, mucor mycosis, alternariosis, penicillosis and blastomycosis. Clinical presentation in allergic and invasive fungal diseases are complicated and currently available diagnostic methods are time consuming and are inadequate.

Again there are many plant diseases caused by the airborne fungi. In India, 5000 various types of plant diseases are recorded till now. Among these 1000 various types are responsible for causing plant pathogens to the important plants. The blight disease of potato, the blast of rice, the rust of wheat, the panama disease of banana, the wilt diseases of crop are the serious plant diseases which caused severe losses to the cultivators.

The allergenic principles of allergic disorders and the fungal spores of various plant pathogens however, differ with species of various types as well as their environment and seasonal changes. The occurrence and prevalence of these spores are related to their production and meteorological parameters like rainfall, temperature, relative humidity, wind velocity etc. and the availability of plant and plant debris which act as a host or substrate for the most commonly encountered fungi, eg - *Cercospora*, *Alternaria*, *Curvularia*, *Cladosporium*, *Furarium* usually during the rainy season. The

atmospheric fungal population decreases due to 'Washing off' by rain, however it gradually increases again after the rains have stopped. In general, the concentration is minimum during hot summer months. However, it can be said that, there is no 'Spore free' month.

Some important human and plant diseases caused by the airborne fungi are listed below

(A) Human diseases :-

Sl. No	Name of the diseases	Name of the causing fungi
1.	Aspergillosis	<i>Aspergillus</i> spp.
2.	Candidiasis	<i>Candida</i> spp.
3.	Histoplasmosis	<i>Histoplasmoses</i> spp.
4.	Mucor mycosis	<i>Mucor</i> spp.
5.	Alternariosis	<i>Alternaria</i> spp.
6.	Penicillosis	<i>Penicillium</i> spp.
7.	Blastomycosis	<i>Blastomyces</i> spp.

(B) Plant diseases :-

Sl. No	Name of the diseases	Name of the causing fungi
1.	Blast of rice	<i>Pyricularia oryzae</i>
2.	Foot rot of rice	<i>Fusarium moniliforme.</i>
3.	Brown spot of rice	<i>Helminthosporium oryzae</i>
4.	Wilt of arhar	<i>Fusarium</i> sp.
5.	Leaf spat of arhar	<i>Cercospora indica</i>
6.	Tikka disease of groundnut	<i>Cercospora personata</i>
7.	Wilt of linseed	<i>Fusarium oxysporum</i>
8.	Black rust or stem rust of wheat	<i>Puccinia graminis</i>
9.	Brown rust or leaf rust of wheat	<i>Puccinia triticina</i>
10.	Yellow rust or stripe rust of wheat	<i>Puccinia glumaram</i>
11.	Loose smut of wheat	<i>Ustilago tritici</i>
12.	Smut of maize	<i>Ustilago zae</i>
13.	Rust of maize	<i>Puccinia sorghi</i>
14.	Rust of jowar	<i>Puccinia purpurea</i>

15.	Rust of bajra	<i>Puccinia penniseti</i>
16.	Blast of ragi	<i>Pyricularia sp.</i>
17.	Wilt of cotton	<i>Fusarium Vasinfectum</i>
18.	Early blight of potato	<i>Alternaria solani</i>
19.	Leaf spot of couliflower	<i>Alternaria brassicola.</i>
20.	Blight of couliflower	<i>Alternaria brassicae</i>
21.	Yellow disease of knol-khol	<i>Furarium oxysporum</i>
22.	Leaf spot of beet	<i>Cercospora beticola</i>
23.	Soft rot of sweet patoto	<i>Rhizopus stolonifer syn.</i>
24.	Wilt disease of tomato	<i>Fusarium bulbigenum</i>
25.	Lady's spot of finger	<i>Cercospora malayensis</i> <i>C abelmoschi</i>
26.	Leaf spot of brinjal	<i>Alternaria melongenae, A. Solani,</i> <i>Cercospora solani and C solani</i> <i>melongenae</i>
27.	Fruit rot of cucumber	<i>Pythium aphanidermatum</i>
28.	Leaf spot of cucumber	<i>Cercospora spp.</i>
29.	Panama disease or Banana wilt	<i>Fusarium oxysporum</i>
30.	Grey leaf spot or blight of coconut	<i>Pestalotia palmarum</i>
31.	Leaf rot of coconut	<i>Helminthosporium halodes</i>
32.	Wilt disease of sugarcane	<i>Furarium moniliforme,</i> <i>Cephalosporum, sacchari</i>

Discussion

The most frequently occurred spore types which eventually contributed to the total airspora, are *Aspergillus*, *Cladosporium*, *Curvularia*, *Penicillium* *Fusarium*, *Alternaria*, *Helminthosporium*, *Mucor* etc. The genus *Aspergillus* and *Cladosporium* are important from allergic point of view. The genus *Furarium* is a severe pathogen causing wilt of number of vegetables leading to considerable damage to the crop. Again *Alternaria* is a severe pathogen causing Early Blight disease of solanaceous vegetables leading to considerable damage. Some of the pathogenic fungi, such as *Curvularia*, *Cercospora*, *Helminthosporium* are generally found responsible to bring about the leaf spot disease incidence. During the clear weather the fungal spores are carried to short or long

distances by the air currents. The low temperature of winter decreases the fungal population in air but again optimum temperature favours airmicrobes from January to April. Though most of the spore types exhibit seasonal variation in the concentration but spores of *Alternaria*, *Cladosporium*, *Curvularia* do not exhibit marked seasonal variations and are present more or less all the year round, this may be due to their wide host range.

Many of the spores are found to be responsible for biopollution in the air and biodeterioration. Biodeterioration includes ridding, mechanical damage, staining and spoilage of material. Spores namely *Aspergillus*, *Cladosporium*, *Penicillium*, *Alternaria*, *Furarium* and *Rhizopus* are responsible for biodeterioration. The process of biodeterioration is hastened due to excessive humidity and poor ventilation. There is a correlation between microbes and environmental conditions, that lead to biodeterioration of biological material.

There are numerous soil, water and airborne fungi which have been implicated or proven to be etiologic agents of human, animal and plant disease. For the most part, very few clinical cases have been recorded and generally even less has been reported concerning their mechanisms of pathogenesis.

Reference:

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