CHAPTER - II

REVIEW OF LITERATURE
Aerobiology is a global science which greatly benefits from the exchange of ideas and experiences of the scientists from different countries and disciplines. Under the umbrella of aerobiology, a variety of biologically significant materials (air spora) such as viruses, bacteria, algae, fungi, spores, lichen fragments, pollen grains, minute insects, spiderys, hairs, scales, wings etc. and abiotic particles or gases affecting living organisms are included (Nilsson 1980).

The inhalation of airborne particles often results in infections of human system and producing allergy disorders, on one hand and cause appreciable damage to the crop on the other. Thus airborne plant pathogens are important and a matter of concern of plant pathologists, medical man and aerobiologists.

The ancient Indian literature had touched some of the modern concepts of plant pathology and allergy. In 'Vedas' (1500-500 B.C.) there are references of plant diseases and their various control measures. The informations regarding the existence of many diseases and treatments for purification of air has also been given. In 'Atharva-veda' and 'Ayurveda' (1000 B.C.), it has been clearly suggested that the inhalation of contaminated air causes diseases of respiratory tract. The utility of 'Agnihotra' as mentioned
in Aryan scripture is for the purification of air. The gases produced by burning of various substances would kill or inhibit microbes in the atmosphere. The intelligentsia often argue about this as a useless game of burning. All these doubts have been cleared due to the scientific investigations of the chemical analysis and it has now been defined that during burning such products or gases are produced which are antibacterial and vermifugal (Satya Prakash 1974). Hippocrates might have been the individual to realize the potential of the aerobiology. Lucretius in about 55 B.C. held quite common views regarding the occurrence of human and animal diseases and he called as atoms which are the cause of diseases. The present day field of aerobiology has its origin in the pioneering experiments of Spallanzani in 1776, who used the methods of aerobiologists to develop the germ theory of diseases. Salisbury (1866) investigated the aerospora in connection with malaria by exposing sheets of glass above marshy places. Blackley (1873) collected pollen grains from the air on adhesive coated microscopic slides at Manchester, England. He also observed some mould spores on the exposed slides. The first systematic work was carried out by Cunningham (1873) in Calcutta. Though he observed a large number of spores in living state, however, he could not find out the relationship between the number, types of airborne particles and prevalence of so-called 'Zymotic diseases. After wards aerobiological research has
been carried out in many countries i.e. United States, United Kingdom, France, Germany, Japan, etc. Since 1930s, India has also been an important contributor. Gregory's book "Microbiology of the atmosphere" (1973) and Edmonds "Aerobiology" (1979) are fundamental handbooks in the subject. Later on investigations were initiated by Prof. K.C. Mehta (1940-52) in India. Our present knowledge of the rust of cereals in India is due to extensive aerobiological researches carried out by him, for observing the survival of rust on the hills, stations were established at different altitude viz., Almora (1645 m), Simla (2134 m), Muktesar (2151 m) and Narkunda (2809 m) and at many more other places. In addition, the use of aeroscope slide and wind tranjectories were also made at different centres in the country to trace the spore showers in relation to the direction of wind and dissemination of rusts in the plains. Equally important like the horizontal and long distance dissemination, is the vertical distribution of spores, since it has been shown that the spores are brought down due to falling rain drops (Joshi et al., 1972, 1974, 1975; Nagarajan and Singh, 1973 and Nagarajan et al., 1976).

The varied cropping pattern with different schedules of disease incidence, studies of aerial routes assumes significant importance in India. However, local dissemination pattern studies also have a useful role. At many places in India this aspect has kept the aerobiologists busy and there

The close relationship between concentration of spores in air, meteorological factors and affected vegetable crops, is interesting. Sulia and Khan (1980) surveyed the airspora at Bangalore market and concluded that, there is a definite cyclic relationship between the air fungal spora of market and the prevalence of market diseases. Recently aerobiology of the market has been investigated by Shastri (1981), which indicated the high concentration of *Tazula, Aspergillus*,...
Helmintosporium, Curvularia, Cladosporium and Alternaria spores in the air.

In recent years considerable attention is provided by various scientists who are actively engaged in different fields of aerobiology. Mammalian aspergillosis, mycotoxoses, facial eczema and other fungal diseases of commercial and domestic animals are receiving attention from veterinary pathologists. Sreearamulu (1961) conducted aerobiological investigations in an open cowshed, however, he obtained a low concentration of spores. This was probably due to the open shed which was diluted by the free air movements. Extensive investigations were carried out in New-Zealand (Flynn et al., 1962) to locate the source concentration, seasonal variations of the spores and their relation with facial eczema of sheep. Mitchell et al. (1959) and Tilak (1974), also carried out aerobiological investigations in sheepshed and found high percentage of Pithomyces, however, disease was not prevalent. Pathak and Mittal (1966) isolated Aspergillus fumigatus from the cervical mucus of a cow suffering from postparturient metritis and so it clearly indicates the role of airborne fungi in the infections of domesticated animals.

Many unicellular, filamentous, colonial, algae are airborne mainly due to wind currents even in the absence of adaptation for take off into air. The work on algae aero-
spora in India is very scanty. Ramalingam (1971), reported five algal types from the air spora of Mysore, Mittal et al. (1973, 1974) studied the aero-allergenic algae of Delhi metropolitan region. Tilak and Vishwe (1978) presented a preliminary report of airborne algae from Aurangabad. Marathe and Reddy (1980) have recently surveyed the airborne algae and identified 21 algal types from Nagpur.

Various plants and animal parts like epidermal hairs, collenchyma, sclerenchyma, parenchyma cells and other tissues, insect scales, wings etc. have also been studied from aero-spora of different areas. Ramalingam (1971) reported the presence of 10.6% of such particles from air of Mysore. Tilak and Bhalke (1979), reported such plants parts from air of Aurangabad with seasonal variations and distribution.

An entirely new field of research of the application of aerobiology has emerged in relation to biodeterioration of materials in stores, equipments, painting library and materials. Many airborne microbes are responsible for biodeterioration. It not only includes mildewing or rotting of substrate but also mechanical damage or which are real manifestations of the interaction of organisms and materials. The pioneering investigation of such type was that of Rajan et al. (1952) from Kanpur. The biological agents and their role in biodeterioration of library materials have been reviewed by Greathouse (1950), Gallow (1963) and Flyate
(1968). Air sampling and exposure of petriplates inside the library clearly indicated the role of several biodeteriogens in decolorization, staining and fixing of library materials. According to these workers, spores of *Curvularia, Aspergillus, Alternaria, Helminthosporium, Fusarium, Irula* and *Cladosporium* were the common constituents. The presence of actinomycetes in the library has been reported by Beljakowa and Kozulini (1961). Some fungi destroy cellulose decomposing binding materials leather and plastic material. Though deterioration of paper has been reported by a number of workers (Armifage, 1949; Kowalik and Sadurska, 1956; Katapalia, 1960; Mukherjee 1973 etc.), the aerobiological investigations concerning with the deterioration was conducted for the first time in India by Tilak and Vishwe (1976).

The world famous wall painting at Ajanta and Elora showed signs of biodeterioration. The role of microbial organisms in deterioration of painting in Ajanta caves was observed by Tilak and Kulkarni (1972) for the first time. A close relationship between the occurrence of fungal spores on the paintings and in the air was observed by them and the fungal biopollutants were found responsible for spoiling the wall painting during favourable meteorological factors.

In the earlier years the aerobiological investigations were done without much reference to meteorological data. The
interest of the meteorologists in aerobiological surveys was primarily towards the atmospheric process involved disseminations of organisms and less in results of such disseminations. Jacobs (1951) has emphasized the need for extensive cooperation and close relationship of aerobiological surveys and associated meteorological conditions. As excellent example of such cooperation is seen in Japan, where a "Operation plant hopper scheme" was made in collaboration with Eichi Inoue and meteorologists; and this has greatly helped to reduce the losses by sucking insects which transport diseases from one plant to another and from one field to the other.

Nabel and Clayton (1963) investigated the fungal flora of air of hospital ward which is an important indoor environment responsible for spread of airborne pathogens. It serve as a reservoir of pathogens with individuals infected with a number of micro-organisms and they are potentially transmitted to other individuals including patients, hospital persons and even visitors.

Aerobiological studies particularly atmospheric pollen and fungal spores have received much importance in recent years because of its relation in various allergic diseases and in dissemination of plant diseases. Several studies were conducted on various aspects. Some of the important contributions are those of Durham (1942, 1946, 1955), Wolf (1943),

Among the plant materials, the pollen grains and
fungal spores constitute a major portion of aeroallergens, and
have a greater bearing on the incidence of allergenic
diseases in men such as hay fever, eczema, urticaria,
asthma etc. In regard the fungal allergy, probably the
first case of fungal sensitivity was reported as early as
1726 by Floyer. Blackley (1873) found a number of mold
spores on the slides exposed for pollen counting. About
half a century later Van Leeuwen (1924) suggested that in
Holland the asthma was caused by “Miasmata” or climatic
allergens. After an year he reported the case of a patient,
sensitive to feathers, who failed to relief in her symptoms
after one containing Kapok cotton. It was then discovered
that the new sensitivity was due to the moulds growing on
the Kapok (Van Leeuwen 1925). He incriminate the spores of
some saprophytic fungi like Aspergillus, Mucor and Penicillium
(which he had earlier designated as “climatic allergens”), as
the causes of asthma. About 50% of his patients gave positive
skin reactions to one or more extracts of the above mentioned
fungi.

Jimenez-Diaz and his co-workers (1929, 1931a, 1931b),
recorded that the climatic asthma was due to the existence
of abundant fungal spores of Aspergillus, Mucor, and
Penicillium in the air and also in the household articles. Simultaneously Hopkins et al. (1930) reported a case of asthma due to Alternaria, growing on vegetables. Another case of asthma caused by Aspergillus fumigatus was cited by Bernton (1930). Prince and his co-workers (Prince and Morrow 1937, 1939, 1954, 1959; Prince 1939, 1965, 1968; Morrow et al., 1964; Prince et al., 1934, 1949, 1961, 1964); and Feinberg and his associates (1935, 1936, 1937, 1939, 1944, Feinberg and Little 1935, 1936), also made comprehensive studies on fungal allergy.

In Britain extensive work on aerobiology has been done by Gregory and his associates (Gregory 1952, 1961, Gregory and Hirst 1952, 1957, Gregory and SreeRamulu 1958), and on occurrence of mould allergy has been done by Hyde and Williams (1946, 1949, 1953, 1959, Hyde et al., 1956).

In India investigations have been made by Agarwal and Shrivpuri (1974) on fungal spores and their role in respiratory allergy. Results of the investigations all over the world have established beyond doubt that the fungal spores play an important role in the etiology of respiratory allergenic disorders. In the field of clinical studies V.P. Chest Institute, Delhi may be credited with the pioneering role played in widening the horizon of knowledge on the subject and laying standards for diagnosis and treatment of allergenic patients. Knowledge of the types and the relative
amounts of fungal spores prevalent in the atmosphere is essential to the allergists since the symptoms of the patients are directly influenced by these factors.

In India, some preliminary work on the airborne fungal spores have been done by Gupta et al. (1960) at Jaipur, Agarwal et al. (1969) at Delhi, Chitaley and Bajaj (1973, 1974, 1975) at Nagpur, Vishnu-Mitrev and Khandelwal (1975) at Lucknow, Bhati and Gaur (1979) from Medinagar, Tilak and Bhalke (1979b, 1979c, 1980) from Aurangabad, and from different parts of the India. Sreeramulu (1959, 1961), Sreeramulu and Ramalingam (1964), Agarwal et al. (1974) and Tilak and Bhalke (1978) have studied the diurnal variations of atmospheric fungal spores population.

In India allergenic diseases are common and it has been estimated that 10% of the population suffers from some or other forms of allergic disorders (Shivpuri 1963a). Pollens of flowers form the most important group of inhalant allergens. Probably Van Halmant (1807) was first to describe annually recurring asthma due to pollen, while Elliotston (1831) is generally credited with taking the first defined stand that hay-fever had its origin in fresh flowers (probably pollens) of grasses. In 19th century a considerable amount of work has been done on pollen allergy and that has been reviewed by Hyde (1969).
Aeropollenological researches in India were initiated by Lakhanpal and Nair at Lucknow and Almora in 1958 and 1960 respectively. Following the above studies elaborated investigations on the airborne pollen and its relation to allergy have been made by Shivpuri and his school at Delhi. During the last one decade aeropollenological studies has been made at a few other centres by different workers, some of the important contributions on the pollen grains have been given by Rajan et al. (1952) from Kanpur, Kalra and Dumbrey (1957), Chaubal and Deodikar (1964) from Poona, Sanghavi et al. (1957), Kaoliwal et al. (1959) from Rajasthan, Agarwal et al. (1969), Shivpuri and his co-workers (1960, 1963) from Delhi, Saha and Kalyansundram (1962) from Pondicherry, Sreeramulu and Ramalingam (1966) from Visakhapatnam, Vishnu Mitre and Asha Khandelwal (1975), Agnihotri and Singh (1975) from Lucknow, Tripathi et al. (1978) from Bhopal, Gaur (1978) from Meerut and Sarna and Govil (1979) from Jaipur and Gaur and Bhati (1979) from Modinagar.

Pollen grains are very well known allergens and in many countries a close collaboration between botanists, palynologists and allergologists have developed and sampling stations for pollen and spores are being set up in connection with the allergy research. Due to vital importance of aerobiological studies of pollen incidence, a programme has recently been started (1977) in France in the laboratorie de palynologie Montpellier. This includes studies in the quantity
and quality of regional pollen spectra, seasonal variations, pollen frequency, relation between palynology with meteorology and immunology. A similar type of extensive co-ordinated project has been undertaken in India for the survey of pollen and spores at different geographical regions of the country.

Our knowledge of the aërospora is presently confined to a few cities and attempts have been made to formulate pollen calendar for Poona (Kalra and Dumbrey 1957), Jaipur and Bikaner, (Kasliwal et al. 1959; Gupta and Singh 1965), Lucknow (Lakhanpal and Nair 1958), Delhi (Shivpuri et al., 1960, Singh et al., 1979, 1980), Calcutta (Chanda 1973), Nagpur (Deshpande and Chitaley 1976), Kalyani (Mandal et al., 1977) and Bhopal (Tripathi et al., 1978).

Insipite of these investigation on aerobiology there is a lack of comprehensive account on atmospheric pollen and spore from different parts of our country. Due to its immediate significance in allergy and microbial problems, regional studies on atmospheric contents are very much essential. In Saugar as yet, except a preliminary work of Claudius (1968) and the author and his co-worker (1981), there appears to be no record for the aerobiological survey of pollen and fungal spores of this area. Taking this into consideration, the present survey was, therefore, undertaken
in order to carry out day to day census of occurrence of pollen and fungal spores in the air to fill up some of the gaps in the knowledge of pollen allergens and to map out a complete pollen and fungal spores calendar of the area.