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REVIEW OF LITERATURE

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AEROBIOLOGY IN INDIA

The concepts of modern aerobiology seems to have been borrowed and adopted by the West from India. This is evident from the ancient literature like 'Vedas' in which information regarding the existence of many diseases and the treatments for purification of air and water has been given. In "Atharva Veda" and Ayurveda which date back to about 1000 B.C. it has been clearly suggested that the inhalation of contaminated air causes diseases of respiratory tract. Lucretius 500 B.C. has been however, credited by many as the first to suggest the role of contaminated air causing respiratory diseases. Thus, the ancient Indian literature have touched some of the modern concepts of plant pathology and allergy. According to "Taittiriyanayka" Aryas use to perform Agnihotra daily in the morning and evening for the purification of air in the house and surrounding. the scientific investigations of the burning substances such as milk products, cereals, medicinal herbs, forest herbs, and vegetables in the Agnihotra and the chemical products or gases produced from them have proved to be antibacterial and vermifugal (Agnihotra Satya Prakash 1974).

OUTDOOR OR EXTRAMURAL AEROBIOLOGY

The first systematic aerobiological work is that of Cunningham (1873) who made aerobiological survey over Calcutta Jail and observed a large number of spores and other vegetable cells in living state. But he was not successful in correlating the types of airborne particles and the prevalence of so called "Zymotic" disease.

The later investigations in ^e Aerobiology are also found to be mainly concentrated on extramural aspects mainly concerned with plant diseases and allergic diseases in human beings. Our present knowledge of the rust of cereals in India is due to extensive aerobiological researches carried by K.C.Mehta (1940-1952); who is credited with finding out the source of perennation of the rusts through uredial stage, the ineffective role of Barbery and the presence of physiological races in India.

Among the plant pathogens wheat rust is the best aerobiologically investigated one. According to Prasad (1973) the circumstantial evidences indicate that some inoculum of wheat rust in India may have its source in West Asia. In India, the studies of aerial routes of dissemination of spores assume significant importance due to varied cropping pattern with different schedules of disease incidences. Even the local dissemination pattern studies have a useful role which has been proved by the important contribution by number of aerobiologists in India. Aerobiological investigation have been carried out with reference to diseases on Rice, Wheat, Jawar, Bajara, Sugarcane, Cotton, Banana, Citrus, Vegetables and other crops by various scientists like Padmnaabhan et al (1953), Sreeramulu (1959,1967,1970), Sreeramulu and Ramkrishna (1970), Sreeramulu and Seshavataram (1962), Sreeramulu and Ramalingam (1963,1964,1965,1966), Sreeramulu and Vittal (1960,1972), Mishra (1972), Mishra and Srivastava (1969,1972), Mishra and Kamal (1971), Sharma and Sinha (1973), Reddi (1974,19760), Tilak and Kulkarni (1970 a, 1970 b), 1975, 1977, 1978, 1980), Tilak and Bhalke (1976, 1978, 1970), Tilak (1974), Bhalke (1980), Chakre (1979), Shastri (1981), Pande (1976), Gaikwad (1974), Mane (1978), Talde (1968), Kulkarni (1971), Dhaware (1976), Hakhe (1960), Tilak and Srinivasulu (1967, 1971), Tilak (1973, 1975, 1980), Tilak

and Vishwe (1976), Tilak and Chakre (1979), Tilak and Shastri (1980), Vishwe (1979).

In the earlier years the activities of aerobiologists were restricted without much reference to meteorology. The data on the seasonal changes in the catches of the total airspora recorded by Cunningham, 1873 for Calcutta, Rajan et al 1952 for Kanpur, Tilak and Kulkarni (1970) for Aurangabad, Sreeramulu and Ramalingam (1966) for Vishakhapatnam clearly indicates that low percentage of aerospora in summer, with onset of monsoon there is gradual increase in number and type of spores reaching peak in September and December. The aerospora in September and October is dominated by basidiospores and ascospores, November and December it is dominated by Saprophytic forms while in summer i.e. May and early January, the relative less numbers are due to unfavourable environmental condition. In India, there is no spore free season.

The investigations by Padmanabhan et al (1953) on incidence of conidia of Helminthosporium oryzae in air over paddy field^s at Cuttack show that the incidence of Helminthosporium oryzae was the lowest from May to August while maximum concentration was noticed from October to December. Sreeramulu and Ramalingam (1966) reported the seasonal changes in the concentration of spores of Trichoconis padwicki, Curvularia lunata, Nigrospora oryzae, Pseudocercospora, Tetraploa, Alternaria and Cercospora over paddy fields. Sengupta et. al. (1963) based on the investigations of five years correlated spores concentration and disease incidence. Tilak and Babu (1980) observed that the spore concentration of Pyricularia pennegeti in air over bajara fields was maximum in the months of August and September. Mane and Tilak (1980)

reported the relationship between sporangial population of Sclerospora graminicola in air over Bajara and its relevans with the growth stages of host and the disease incidence.

The survey of atmospheric spores at Modinagar by Bhatia and Gaur (1979) indicate the presence of over 47 spore types, varying in concentration from day to day, month to month and season to season, five distinct types of diurnal periodicity patterns were recognised by Sreeramulu 1967. Tilak (1980) observed close relationship between rainfall and release of ascospores in the airspora of Aurangabad.

The shape, size, number and the nature of microbes serve as an important criteria for their availability in the air. Bhatia and Gaur (1979) observed that most of the spores abounding in air are small in size, produced in large scale and have comparatively simple structure e.g. Aspergillus, Cladosporium, Mucor, Penicillium etc. The spores of Alternaria, Helminthosporium, Cercospora, Curvularia, are large in size but are very light in weight.

The air also contains algal spores and some other biological particulates including plant and insects parts.

Work on the algal airspora in India is very limited. Aeroallergic algae of Delhi metropolitan region was studied by Mittal et al (1973,1974). Marathe and Reddy (1980) reported 21 algal types in aerospora from Nagpur. Tilak and Vishwe (1978) presented a preliminary report of airborne algae from Aurangabad (Algal propagules because of their heavier nature are found up to a hight of 2 m). Five algal types were reported in the aerospora from Mysore by Ramalingam (1971). From Aurangabad Tilak and Vishwe (1978) reported diatoms and Myxomycetes. Agnihotri et al (1977) investigated the lichen

component of airspora with reference to allergenicity in hilly district of Uttar Pradesh.

The other biological particles in the aerospora include epidermal hairs, xylem and fibres, collenchyma, sclerenchyma, parenchyma and other ^{plant} tissues. The occurrence of such particles are reported by Ramalingam (1971) Mysore, Tilak (1974) from Aurangabad. Tilak and Bhalke (1979) reported the occurrence and seasonal variations and distribution of various insect parts from Aurangabad. It is noticed that humid and windy condition favours the occurrence of insects in air.

AEROBIOLOGY AND ALLERGY

The airborne fungal spores and pollen are responsible for many human allergic diseases such as asthma and seasonal allergic rhinitis. After Cunningham¹⁹ (1873) pioneering investigations to correlate the number and types of airborne microbes and disease incidence there appeared a long gap. Such studies regained importance at few places like Delhi, Jaipur, Kanpur, Lucknow, Calcutta, Aurangabad, and few other places. However, the systematic studies were due to consistent efforts of Shivpuri and his co-workers at Vallabhbhai Patel Chest Institute, New Delhi which even now serve as a nucleus for such studies. As it is concerned with human health much importance has been given to this aspect which is evident from the work of Shivpuri (1964), Baruah and Chetia (1966), Baruah (1969), Shivpuri and Singh (1971), Tilak and Vishwe (1980), Chanda (1972, 1973), Chanda and Ganguly (1976), Chanda and Mandal (1978), Agarwal et al (1969, 1973), Gaur (1978), Nair (1963), Reddi (1974), Chaubal and Deodikar (1964), Agashe et al (1980) Appana (1980), Bora and Barauh (1980), Gupta et al (1960), Ramalingam (1960), Shivpuri and Agarwal (1964), Shukla and Mishra (1980), Reddi et al (1974), Shivpuri (1963, 1965).

Due to great diversity of vegetation and varied meteorological factors the aeroallergens are also of different types from place to place. The importance of pollen grains as allergens has been emphasized and the pollen calendars of various regions have been prepared. In India Allergenic pollen mainly belong to families Gramineae, Chenopodiaceae, Amaranth^aaceae and Asteraceae which is evident from the work^s of Singh and Shivpuri (1971) from Delhi, Vishnu Mitre et al (1973) from Lucknow, Kasliwal et al (1958, 1959), from Jaipur, Chanda et al (1972, 1973, 1976, 1977, 1980), from Calcutta, Deshpande and Chitale (1976) from Nagpur, Tilak and Vishwe (1979) studies on fungal spores responsible for allergic disorders are made by Gupta et al (1960) from Jaipur, Chitale and Bajaj (1973, 1974, 1975) from Nagpur, Tilak (1974), Tilak and Bhalke (1979, 1979, 1980) from Aurangabad, Agarwal et al (1969) from Delhi, Vishnu Mitre and Khandelwal (1973) from Lucknow and many others from different parts of India. Alternaria, Cladosporium, Curvularia, Aspergillus, Penicillium, constitute the major^{fungal} types of which Cladosporium the dominant one (is) followed by Alternaria. Diurnal variations in fungal population^s have been observed by Sreeramulu (1958, 1961), Sreeramulu and Ramalingam (1964), Agarwal et al (1974), Tilak and Bhalke (1978).

from which place?

In India the diagnosis of pollen allergy is due to clinical investigations utilizing pollenspore antigen for the treatment of respiratory allergy. The work is being carried out at U.P. chest institute at Delhi and others at Jaipur, Calcutta, Lucknow and Aurangabad. Important contribution^s are made by Shivpuri and Dua (1963), Shivpuri and Singh (1965), Agarwal and Shivpuri (1974), Chanda and Mandal (1978) etc.

INDOOR OR INTRAMURAL AEROBIOLOGY

The results of the aerobiological work done in India clearly indicates the rich and varied airspora. Many airborne microbes are responsible for biodeterioration of storage materials, equipments, library materials and archives. The biodeterioration not only includes mildewing or rotting of substrate but also mechanical damage or fundamental impairment of materials which are real ^emanifestation of the interaction of organism and material.

Very little attention has been paid to this aspect of aerobiology in India which is evident from the literature available. The pioneering work of such type was that of Rajan et al (1952) from Kanpur.

Studies in the microbial pollution of air inside a warehouse were carried out at Aurangabad to find out the composition of airborne biopollutants, their seasonal variations and incidence of diseases of cereal grains in storage by Tilak and Chakre (1978). The biopollutants recorded are Rhizopus, Penicillium, Aspergillus, Alternaria, Cladosporium, Helminthosporium, and Curvularia. Insect scales and fragments also formed part of the biopollutants. Khilare (1993) recorded 37 types of biopollutants in warehouse at Kolhapur; Zahid et. al. (1994) recorded biopollutants inside warehouse at Ahmednagar (M.S.); Tarar and Charjan (1994) recorded 18 distinct fungal spore types in 11 seed godowns at Nagpur. Giri and Saoji (1994) recorded biopollutants inside residential quarters and food storage places.

Another important investigation is the role of microbial organisms in deterioration of paintings. Tilak and Kulkarni (1972) studied the comparative account of biopollutants inside and outside Ajanta caves and the same studies were further extended to Ellora caves ^{by} Tilak et al (1972). The world famous Ajanta paintings showed signs of biodeterioration and the data clearly indicate a

close relationship between the occurrence of fungal spores on the paintings and in the air thus proving their close relationship.

Tilak and Babu and Talaib (1980) surveyed the allergenic fungal spores inside the hospital wards and encountered 65 spore types. Kulkarni and Patil (1981) studied the aerospora inside hospital ward at Kolhapur.

this does not figures in the Bibliography.

Rati, Jayaprakash and Ramalingam (1980) studied air spora of poultry shed and concluded that the concentration of microbes inside poultry shed was 10-100 times higher than that of adjacent outdoor environment. Mycotoxic and pathogenic organism^s occurred in high concentration inside poultry shed.

Pady and Karmarker (1981) studied the aerospora inside greenhouse and found that concentration of biopollutants were maximum in early hours of morning compared to evening because of high humidity inside the green house.

A vegetable market which is a semi-open place is sure to contain a good concentration of aerospora because of rotting of the fruits and vegetables. Shastri (1981) investigation suggest a close relationship between concentration of spores in the air meteorological factors and affected vegetables and fruits. A survey of aerospora inside market at Bangalore was made by Sulia and Khan (1980).

The allergic individual show acute symptoms of allergy on inhalation of indoor air full of dust. The house dust contain allergic constituents like Mites and Mold spores. Dar et al (1973) collected dust samples from various places of dwellings in differnet parts of India. The commonest mite was Dermatophagoides fabrinae. It is also observed that house dust contain mixture of haris, molds, bacteria, decomposed particles of cloths and furniture, small insects etc. Such intramural studies in the dwelling of man would serve a very useful purpose in the treatment of allergy.

Lynderberg and Archew (1931) first pointed out that indoor air is responsible for biodeterioration of library books and it is equally damaging even when it is too dry or too wet. The indoor microflora depends on the number and kind of organisms present inside and the mechanical movement within the enclosed space (Madeliva and Linton (1974)) and it is also depends on the physical condition of that particular area.

Kowalik and Sadurska (1956) and Beijakova (1961), Aleksy (1965) reported presence of actinomycetes in the library. Plumbe (1964) noted the presence of fungal spores in the atmosphere of library and also on the old books. Whenever these spores get exposed to favourable conditions they attack the paper and deterioration of paper starts.

The deterioration of library material by biological agents such as fungi, bacteria, and actinomycetes has been reviewed by Greathouse (1950), Gallow and Fausta (1963) and Flyate (1968).

According to Gregory (1973) microbial concentration in indoors varies greatly with amount of mechanical and human activity. Armitage (1949), Kowalik et al (1962) reported that in library same fungi destroy cellulose decomposing binding materials, leather and plastic materials.

In India Kathapalia (1960) and Mukherji (1973) first showed the deterioration of papers by activity of microorganism.

The biodeterioration agents inside library and their significance in book deterioration was carried out in this region by Tilak and Vishwe (1975) followed by Tilak, Pillai and Saibaba (1982) and Vaidya (1990).

The review of data available on aerobiology indicates that the subject is of greater importance and thus it has evolved world wide interest. There is an encouragement to evolve the standardised sampling techniques and equipments for controlling and preventing the disastrous disease out-break and pollinosis. The International Association for Aerobiology and Indian Aerobiological Society help to promulgate new approaches to Aerobiology.

In recent 5th International Conference on Aerobiology held at Bangalore, India, 245 research papers were received representing recent research in the field of Aerobiology, plant pathology, epidemiology of plant diseases, allergy in relation to human response, drug therapy, immunotherapy in allergic disorders and effects of environmental pollution. From India, there were 147 research papers based on various aspects of aerobiology in India. Among them 4 were based on study of aeroflora inside library (Sangeeta R.Ahuja, B.N.Pande; Pandey (Tiwari), P. and Tiwari K.L, A.A.Saoji, and S.K.Giri, Chitnavis and Walawalkar).

However, this type of work has not been extensively carried out from Kolhapur city. The data available indicate that the work has been done in relation to general aerospora (Chaubal and Kotmire-1982), Hospital aerospora (Patil and Kulkarni 1981), Chaubal and Kotmire 1985), aerospora in relation to Mellitopalynology (Chaubal 1981, Chaubal and Kotmire 1963) and human allergy (Chaubal and Gadve 1979). Hence the ^{study of} aerospora inside the library building of Shivaji University, Kolhapur was under taken. As the aerospora is harmful to library material as well as it is one of ^{the} ^{source} of human allergens, the air monitoring has been carried out.