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SEASONAL DISTRIBUTION OF AERO ALGAL ALLERGENS IN THE WETLANDS OF KANPUR

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ABSTRACT

The wetlands of Kanpur are phyto-geographically situated in the rich Indo-Gangetic plains beset seasonal diversity.The area has wetlands spread in rural, urban and forest land. It is well known that aero-algology is a developing field of the advanced studies in algae and there are wide ramifications in aerobiology and pollution. A study of aero-algal allergens (using gravity slide sampler method and agar medium plate method) was made in the wetlands of Kanpur. About twenty aero-algal allergen were recorded through the study- *Ankistrodesmus falcatus, Chlorella vulgaris, Chlorococcum humicola, Chlorococcum infusionum, Scenedesmus bijuga, Scenedesmus quadricauda, Spirogyra affinis, Nitzschia palea, Anabaena fertilissima, Anabaena iyengarii var. attenuata, Lyngbya hieronymusii, Microcystis flos-aquae, Nostoc linckia, Nostoc muscorum, Oscillatoria angustissima, Oscillatoria curviceps, Oscillatoria formosa, Oscillatoria subbrevis, Phormidium fragile, Phormidium tenue*.The disease known to be caused by them have also been highlighted. A correlated study was made between the allergenics occuring in wetlands of Kanpur and aero-allergenic algae.The study of both types of allergenic algae has focused attention on the cyclic transmission of aquatic as well as aero-algal allergenics.There was a marked resemblance between aero-algal allergenics and wetland allergenics. Observations on periodicity, succession and quantitative distribution of these algae in wetlands of Kanpur can be of great importance in solving the problems caused by algal allergenic. The total percentage of algal occurrence ranged from 1.155 (*Chlorococcum humicola*) to 10.700 (*Phormidium tenue*). The main transmigration agency can be said to be wind which maintain algal fragments until the return of suitable conditions. Further research on airborne allergenic algae specially in urban area can be helpful for protection of human health.

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INTRODUCTION

Aero-algal allergens have been reported earlier (Lewis and Elvin-Lewis, 1977; Shukla, 1983) from water accumulation and water work system of Kanpur. Algal-allergens of Kanpur include 39 species belonging to 9 genera (Shukla, 1983). There are 26 spp. of algae recorded from the Ganga between Naramau and Bithoor by Gupta (1991), which are causal organisms for the spread of allergenic diseases. In India, experimental studies were conducted on air borne algae. Around one third of cyanobacterial blooms are capable of producing toxins (Freeman, 2005) like haplotoxins, microcystin - LR, -RR, -LA, -YR and cylindrospermopsin and neurotoxin anatoxin -a (Rattapoom *et al.*, 2003; Westrick *et al.,* 2006; Yen *et al.,* 2006) that cause death of higher animals such as fish, birds and cattle. The atmosphere has been recognised as a 'spora' due to the presence of microorganisms including microalgae which indulge in allergies and air borne disease (Gregory, 1967). Mittal *et al.,* (1979) observed a number of air borne algae at Delhi by exposing slides and using culture plate technique. There are other fragmentary reports of airborne algae from Nagpur (Marathe and Reddy, 1980), Aurangabad (Tilak and Vishwe, 1978) and Bijapur (Mane, 1982).Quantitative abundance of allergenic forms is directly linked with spread of allergenic diseases. Allergenic problems caused due to such algae are rhinitis, bronchial asthma, hypersensitivity, pneumonitis, bronchial provocation, mortality in fish, cattle and animals, coupled with symptoms of partial paralysis, loss of balance, general weakness and photosensitization of skin (Shukla, 1989 and Genitsaris, *et al*., 2011). Carson and Brown (1976) noted that meteorological conditions are important for the release of algae from their natural environment and their survival, deposition and growth in new environment. Wee (1982) and Rosas *et al*., (1989) suggested that rainfall, humidity temperature and wind affected their survival. Sharma *et al.,* (2006) have studied the diversity and seasonal variations of viable algal particles in the atmosphere of a subtropical city in India and also the relationship between meteorological factors and airborne algal diversity.Although airborne algae and cyanobacteria form a considerable part of bioaerosols as reviewed by Jain and Gupta (1998) and Genitsaris *et al*., (2011) they are most understudied. The present investigation describes aero-algal allergens from wetlands of Kanpur, their periodicity, succession and quantitative distribution and emphasizes their implication in public health hazard.

MATERIALS AND METHODS

Gravity slide samplers method was used to collect aero-algal species. The samplers were placed at 5 places on the wetlands of Kanpur. The adhesive used in microslides was glycerine jelly. After 24 hr. three slides per wetland were examined under microscope for the identification of aero-algae. This process was repeated after every 2 weeks.

Apart from this, petridishes of 3" diameter containing 10 mL of Beneck agar medium (modified by De, 1939) / Chu agar medium (1942) were exposed for 24 hr. at the same sampling sites.They were then brought to the laboratory and cultured at 25°C under artificial light for two weeks. Algal slides were made and Camera Lucida figures prepared. On the basis of measurements, the algae were identified using standard texts (Van Heurck, 1896; Tiffany and Britton, 1952; Desikachary, 1959; Philipose, 1967; Prescott, 1982). The periodicity, succession and quantitative distribution of these algae in these wetlands were also recorded between Jan. 2008 to Dec. 2008.

RESULTS AND DISCUSSION

Algae exhibited specific periodicity in the wetlands of Kanpur (Table 1). These aero-algal species are causal organisms for allergenic diseases. Some of them are only found periodically while others grow throughout the year. Periodicity and quantitative abundance of such algae determine the extent of allergenic disease spread. Allergenic significance of algae from Kanpur (species of *Chlorella* and *Chlorococcum*) has been emphasised earlier (Shukla,1983). Allergenicity of eight strains of *Chlorella*

Table -1 : Periodicity, Succession and Quantitative distribution of algae in wetlands of Kanpur

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	% Occurrence of Algae
Ankistrodesmus falcatus									R	R	C	R	3.205
Chlorella vulgaris		R		R						C	R		3.805
Chlorococcum humicola			R		R								1.155
Chlorococcum infusionum		R			R								1.98
Scenedesmus bijuga		R	R					R	C	R			3.014
Scenedesmus quadricauda			R	R						R	C	R	4.01
Spirogyra affinis	R	R							C	A	C	C	9.73
Nitzschia palea	C	C	A	R		R					R		7.26
Anabaena fertilissima	R	A	A	C							C	R	5.925
Anabaena iyengarii var. attenuata		R	R	R	R						R		1.635
Lyngbya hieronymusii	R	R	R								C	C	3.56
Microcystis aeruginosa	R	R									R		1.931
Nostoc linckia	C	C	A	R							R	C	7.69
Nostoc muscorum	C	C							R	C			4.52
Oscillatoria angustissima			C	C	R						R		5.56
Oscillatoria curviceps				R	R					R	R		1.8
Oscillatoria formosa	C	C	A	R									8.25
Oscillatoria subbrevis	A	A	C	A							R		9.67
Phormidium fragile				R	C	C	R						4.6
Phormidium tenue	C	A					R			R	R	A	10.7

Abbreviations used : A = Abundant above 60%, C = Common = 30% to 60%, R = Rare = below 30% of total algae

(Tiberg and Einarsson, 1989), *Phormidium fragile* and *Nostoc muscorum* have been reported (Sharma and Rai, 2008). There are earlier reports about the toxicity of algae in the respiratory tracts of humans (Albert, 1960; Fogg, 1969) but, till now, no allergenic algal calendar has been prepared. Genitsaris *et al.,* 2011 have identified 52 taxa posing human health problems of which 38 have been experimentally shown to cause health problems and 14 are known to produce toxins in their surroundings.

Algae which exhibit their growth in the wetlands here are known to be significant propagators of allergenic diseases and comprise of *Ankistrodesmus falcatus* (Fig. 1a), *Chlorella vulgaris* (Fig. 1b), *Chlorococcum humicola* (Fig. 1c), *Chlorococcum infusionum* (Fig. 1d), *Scenedesmus bijuga* (Fig. 1e), *Scenedesmus quadricauda* (Fig. 1f), *Spirogyra affinis* (Fig. 1g), *Nitzschia palea* (Fig. 1h), *Anabaena fertilissima* (Fig. 1i), *Anabaena iyengarii* var. *attenuata* (Fig. 1j), *Lyngbya hieronymusii* (Fig. 1k), *Microcystis flos-aquae* (Fig. 1l), *Nostoc linckia* (Fig. 1m), *Nostoc muscorum* (Fig. 1n), *Oscillatoria angustissima* (Fig. 1o), *Oscillatoria curviceps* (Fig. 1p), *Oscillatoria formosa* (Fig. 1q), *Oscillatoria subbrevis* (Fig. 1r), *Phormidium fragile* (Fig. 1s), *Phormidium tenue* (Fig. 1t). All these genuses have been reported to cause allergy, Hay fever, Dermatitis, Rhinitis or their toxins may induce respiratory problems (Table 2). These 20 species belonging to 12 genera have been reported from the wetlands of Kanpur for the first time. There was a marked resemblance between aero-algal allergens and wetland allergens.

The observations suggest that algae occurring in wetlands of Kanpur are transmigrated through the agency of wind as the river water recedes. The algal fragments which keep blowing with the wind may return to a suitable

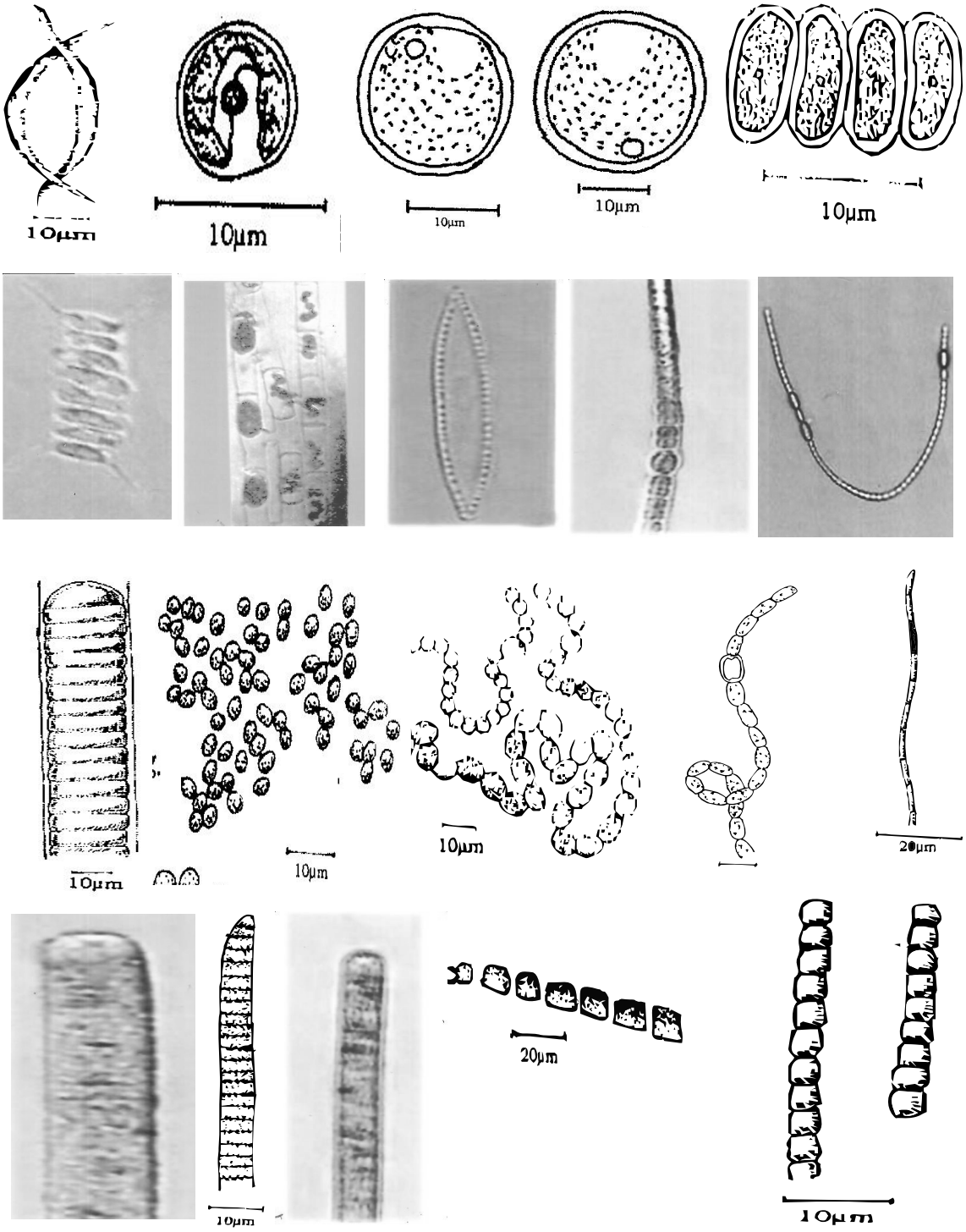

Figure 1: a. ***Ankistrodesmus falcatus*****, b.** ***Chlorella vulgaris*****, c.** ***Chlorococcum humicola*****, d.** ***Chlorococcum infusionum*****, e.***Scenedesmus bijuga***, f.** ***Scenedesmus quadricauda*****, g.** ***Spirogyra affinis*****, h.** ***Nitzschia palea*****, i.** ***Anabaena fertilissima*****, j.***Anabaena iyengarii* **var.** ***attenuata*****, k.** ***Lyngbya hieronymusii*****, l.** ***Microcystis flos-aquae*****, m.** ***Nostoc linckia*****, n.** ***Nostoc muscorum*****, o.** ***Oscillatoria angustissima*****, p.** ***Oscillatoria curviceps*****, q.** ***Oscillatoria formosa*****, r.** ***Oscillatoria subbrevis*****, s.***Phormidium fragile***, t.** ***Phormidium tenue*****.**

Table 2 : Health risks of some airborne algae found in wetlands of Kanpur.

S.No.	Airborne algae	Health risk	Reported or reviewed by
1.	*Ankistrodesmus sp.*	Allergy or produce toxins	Bernstein and Safferman, 1973
2.	*Chlorella sp.*	Allergy, Rhinitis Hypersensitivity	Genitsaris *et al.*, 2011
3.	*Chlorococcum sp.*	Allergy	Genitsaris *et al.*, 2011
4.	*Scenedesmus sp.*	Dermatitis, Allergy	Genitsaris *et al.*, 2011
5.	*Spirogyra sp.*	Allergy	Tripathi *et al.*, 1990
6.	*Nitzschia sp.*	Allergy	Genitsaris *et al.*, 2011
7.	*Anabaena sp.*	Toxin producer, Allergy, Dermatitis, Rhinitis	Genitsaris *et al.*, 2011
8.	*Lyngbya sp.*	Toxin producer, Allergy, Dermatitis, Swelling of mucous membrane of eyes and nose.	Genitsaris *et al.*, 2011
9.	*Microcystis sp.*	Toxin producer.	Genitsaris *et al.*, 2011
10.	*Nostoc sp.*	Toxin producer, Allergy	Genitsaris *et al.*, 2011
11.	*Oscillatoria sp.*	Toxin producer, Hay fever	Genitsaris *et al.*, 2011
12.	*Phormidium sp.*	Allergy.	Genitsaris *et al.*, 2011

environment and revive again. Such aero-algal transmission is substantiated through observation of algae in exposed Petridishes containing Beneck agar medium (modified by De, 1939)/ Chu agar medium (1942).

The results are of pivotal significance in forming of an aero-algal allergenic calendar for assisting clinical and therapeutic treatment of affected patients.

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