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ROLE OF ALGAE IN ASSESMENT OF POLLUTION STATUS OF RIVER GANGA AT KANPUR, INDIA

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ABSTRACT

Algal samples were collected from two sampling stations viz. Bithoor (Upstream) and Jajmau (Downstream) of river Ganga at Kanpur and total 51 genera spread over 228 species belonging to Chlorophyceae, Cyanophyceae, Euglenophyceae and Bacillariophyceae have been identified. The most dominating group was Cyanophyceae followed by Bacillariophyceae, Chlorophyceae and Euglenophyceae. During the present investigation 34 genera and 36 species were identified as indicator of organic pollution (OP). The Palmer's Pollution Index (PPI) of both genus and species for Bithoor were 29, 28 and Jajmau 31, 32 respectively. Thus, river Ganga at Kanpur was highly polluted with organic contaminants.

Key words: Algae, Organic Pollution (OP), Palmer's Pollution Index (PPI)

INTRODUCTION

Rivers are major source for freshwater from time immemorial and most of civilizations developed on or near the banks of rivers; even today most of cities are situated on or near the banks of river. Rivers are considered as more appropriate resources of freshwater for the domestic, agriculture and industrial requirements. Thus rivers are polluted due to indirect or direct disposal of organic substances such as domestic sewage, food wastes, agricultural wastes and industrial effluents. In India most of rivers are facing acute problem of pollution. In India the river Ganga considered as most significant and holy. It originated from Gangotri and falls into Bay of Bengal. In this course this river flows from several cities, towns and villages and gets various harmful polluting contaminants. The Kanpur is an industrial hub of North-India, called as Manchester of North- India, also situated on the bank of river Ganga. The river at Kanpur is highly polluted than other nearby cities and this condition of river provide an opportunity to proliferate various kinds of micro- organisms along with algae. The algae can successfully survive and proliferate in both polluted and non-polluted water and are considered as primary producers of aquatic ecosystems. Thus, algae are potential tool to assess the degree of pollution (Palmer, 1969; Patrick, 1965, 1972; Rai and Kumar,

1980; Trivedi, 1988; Maske and Sangolkar, 2010; Rastogi, et al., 2014; Davidson, et al., 2014) or indicator of water pollution (Katsiapi, et al., 2011;

Kshrisagar and Gunale, 2011; Kshrisagar, et al., 2012; Kshrisagar, 2013; Hosmani, 2013; Khare and Saxena, 2013). The present investigation was conducted to evaluate trophic status of river Ganga at Kanpur by using Algal Pollution Indices proposed by Palmer (1969).

MATERIALS AND METHODS

An exhaustive collection of algal samples were made from Upstream (Bithoor) and Downstream (Jajmau) with a view to record algal flora of Ganga at Kanpur. Algal samples were collected at monthly interval during the period from March, 2016 to February, 2017. The algae were collected regularly in specimen tubes and brought to the laboratory in time and simultaneously preserved in FAA. The samples were microscopically examined, Camera- Lucida diagrams prepared and measurements recorded. The photographs of some major forms were also taken. On the basis of structure and measurement algae were identified using standard text i.e. Tiffany and Britton, 1952; Desikachary, 1959; Philipose, 1967; Prescott, 1982. The organic pollution (OP) of river has been estimated by using Palmer's Pollution Index (PPI) proposed by Palmer (1969). Most pollution tolerant genera and species have also been listed for each sampling station.

Reference range of scores proposed by Palmer (1969) for determination of organic pollution (OP)

0-9 Lack of organic pollution 11-15 Moderate pollution

16-20 Probable high organic pollution 21 or more highly polluted with organic contaminants

RESULTS AND DISCUSSION

The first co-relation between algae and organic pollution was established by Pearsall (1932). He summarized that some species of algal genera such as Ankistrodesmus, Chlorella, Closterium, Cosmarium, Eudorina, Pandorina, Scenedesmus, Nitzschia, Naavicula, Anabaena and Spirulina are frequently found in organically polluted waters. In 1969 Palmer made a systematic, well organized and most acceptable tabulation of most pollution tolerant algal genera and species with their ratings and scores. He considered 60 genera and 80 species as most pollution tolerant. Some genera like Euglena, Oscillatoria, Scenedesmus, Chlorella, Nitzschia,

Navicula, Stigeoclonium, Ankistrodesmus, Closterium, Cosmarium, Microcystis, Melosira etc are highly tolerated to organic pollution. These findings also supported by various workers (Patrick, 1972; Ratnasabapathy, 1975; Gunale and

Balakrishnan, 1981; More and Nandan, 2000; Kshrisagar, et al., 2012; Kshrisagar, 2013; Hosmani, 2013; Khare and Saxena, 2013). According to Palmer (1969) some algal species such as Euglena viridis, Nitzschia palea, Oscillatoria limosa, O. tenuis, O. chalybea, O. princeps, Scenedesmus quadricauda, Stigeoclonium tenue, Synedra ulna, Ankistrodesmus falcatus, Chlorella vulgaria, Melosira varians, Navcula cryptocephala etc. are frequently found in organically polluted waters.

During the present investigations total 34 pollution tolerant genera were identified from Bithoor (Upstream) and Jajmau (Downstream) stations of river Ganga at Kanpur during the period from March, 2016 to February, 2017.The upstream site exhibited 20 genera and downstream site 25 genera (Table 1). Similarly, 36 pollution tolerant species were recorded from both sites of river, the upstream represented by 22 species and downstream with 27 species (Table 2). The PPI for both sites of river Ganga at Kanpur on the behalf of algal genera (Table 3) and species (Table 4) were 29, 28 for Upstream (Bithoor) and 31, 32 for Downstream (Jajmau). Thus, these scores were very high and we concluded that river Ganga at Kanpur was highly polluted with organic contaminants.

Table 1: Pollution tolerant algal genera from Upstream and Downstream of river Ganga at Kanpur in the order of decreasing emphasis (Palmer, 1969)

Actinastrum	*24*	-	+
Cladophora	*24*	+	-
Achnanthes	*19*	-	+
Chlorococcum	*17*	-	+
Asterionella	*17*	+	-
Cosmarium	*17*	+	-
Stauroneis	*16*	-	+
Selenastrum	*15*	-	+
Total Genera		*20*	*25*

Algal Species	***Total Points***	***Bithoor (Upstream)***	***Jajmau (Downstream***
Euglena viridis	*93*	+	+
Nitzschia palea	*69*	-	+
Oscillatoria limosa	*42*	+	+
Scenedesmus quadricauda	*41*	-	+
Oscillatoria tenuis	*40*	+	-
Stigeoclonium tenue	*34*	-	+
Synedra ulna	*33*	+	-
Ankistrodesmus falcatus	*32*	+	-
Oscillatoria chlorina	*29*	+	+
Chlorella vulgaris	*29*	-	+
Melosira varians	*28*	+	-
Cyclotella meneghiniana	*27*	-	+
Euglena gracilis	*26*	+	+
Nitzschia acicularis	*26*	+	+
Navicula cryptocephala	*25*	-	+
Oscillatoria princeps	*24*	+	+
Gomphonema parvulum	*23*	+	-

Oscillatoria chalybea	*22*	+	-
Closterium acerosum	*21*	+	+
Scenedesmus obliquus	*21*	-	+
Chlorella pyrenoidosa	*20*	-	+
Euglena acus	*20*	-	+
Oscillatoria Formosa	*19*	+	+
Phacus pyrum	*18*	+	-
Melosira granulate	*18*	+	-
Pediastrum boryanum	*18*	-	+
Euglena polymorpha	*16*	-	+
Euglena pisiformis	*15*	-	+
Actinastrum hantzschii	*15*	-	+
Synedra acus	*14*	+	+
Achnanthes minutissima	*13*	-	+
Scenedesmus dimorphus	*12*	-	+
Fragilaria crotonensis	*12*	+	-
Euglena intermedia	*12*	+	+
Pediastrum duplex	*12*	+	+
Cladophora glomerata	*11*	+	+
Total Species		***22***	***27***

Table 2: Pollution tolerant algal species from Upstream and Downstream of river Ganga at Kanpur in the order of decreasing emphasis (Palmer, 1969)

Algal Genus	*Total Points*	*Bithoor (Upstream)*	*Jajmau (Downstream*
Euglena	*172*	+	+
Oscillatoria	*161*	+	+
Scenedesmus	*112*	+	+
Chlorella	*103*	-	+
Nitzschia	*98*	+	+
Navicula	*92*	+	+
Stigeoclonium	*69*	-	+
Synedra	*58*	+	+
Ankistrodesmus	*57*	+	-
Phacus	*57*	+	-

Phormidium	*52*	-	+
Melosira	*51*	+	-
Gomphonema	*48*	+	-
Cyclotella	*47*	-	+
Closterium	*45*	+	+
Microcystis	*39*	-	+
Spirogyra	*37*	+	+
Anabaena	*36*	+	+
Pediastrum	*35*	-	+
Arthrospira	*34*	+	-
Fragilaria	*33*	+	-
Ulothrix	*33*	+	+
Surirella	*33*	-	+
Lyngbya	*28*	+	+
Spirulina	*25*	+	+
Cymbella	*24*	-	+

Table 3: Palmer's Pollution Index (PPI) on the basis of algal genera for Up and Downstream of River Ganga at Kanpur

Algal Genus	***Bithoor (Upstream)***	***Jajmau (Downstream***
Euglena	*5*	*5*
Oscillatoria	*5*	*5*
Scenedesmus	*4*	*4*
Chlorella	-	*3*
Nitzschia	*3*	*3*
Navicula	*3*	*3*
Stigeoclonium	-	*2*
Synedra	*2*	*2*
Ankistrodesmus	*2*	-
Phacus	*2*	-
Phormidium	-	*1*
Melosira	*1*	-
Gomphonema	*1*	-
Cyclotella	-	*1*
Closterium	*1*	*1*
Microcystis	-	*1*
PPI	***29***	***31***

Table 4: Palmer's Pollution Index (PPI) on the basis of algal species for Up and Downstream of River Ganga at Kanpur

Algal Species	***Bithoor (Upstream)***	***Jajmau (Downstream***
Euglena viridis	*6*	*6*
Nitzschia palea	-	*5*

Oscillatoria limosa	*4*	*4*
Scenedesmus quadricauda	*-*	*4*
Oscillatoria tenuis	*4*	*-*
Stigeoclonium tenue	*-*	*3*
Synedra ulna	*3*	*-*
Ankistrodesmus falcatus	*3*	*-*
Oscillatoria chlorina	*2*	*2*
Chlorella vulgaris	*-*	*2*
Melosira varians	*2*	*-*
Cyclotella meneghiniana	*-*	*2*
Euglena gracilis	*1*	*1*
Nitzschia acicularis	*1*	*1*
Navicula cryptocephala	*-*	*1*
Oscillatoria princeps	*1*	*1*
Gomphonema parvulum	*1*	*-*
PPI	***28***	***32***

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