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RESEARCH ARTICLE

Studies on seasonal variation of *Chroococcales* (*Cyanophyta*), Goalpara district, Assam, India

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SUMMARY

In the present investigation of Goalpara district, the total number of *chroococcales* were fifty seven. From the total number of species twelve numbers of genera were like *Gomphospheria* 1.75 per cent, *Chlorogloea* 1.75 per cent, *Coelosphaerium* 3.50 per cent, *Dactylococoopsis* 3.50 per cent, *Synechocystis* 3.50 per cent, *Merismopodia* 5.26 per cent, *Gloeothece* 5.26 per cent, *Aphanothece* 7.01 per cent, *Microcystis* 12.28 per cent, *Aphanocapsa* 14.03 per cent, *Chroococcus* 15.78 per cent and *Gloeocapsa* 26.31 per cent. The *Gloeocapsa* species diversity were maximum where *Microcystis flos-aquae*, *Microcystis lamelliformis, Microcystis aeruginosa* dominant in post-monsoon season. The flora was found to be abundant during post-monsoon and occasionally found in pre-monsoon and monsoon season.

Key Words **:** Seasonal variation, *Chroococcales*

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Algae that form the source of food and oxygen for heterotrophic organisms in aquatic habitats, directly affect primary productivity by forming first circle of food chain. Algae have a great significance, since these primary producers are used in biomonitoring as indicator organisms of water polutions (Shektar *et al.,* 2008), in ecological studies of extraordinary environments such as mangroves (Saravanakumar *et al*., 2008) or in exploring sustainable water resources (Bhuiyan and Gupta, 2007). Cyanobacterial inoculation was found to have a significant additive effect at all levels of nitrogen fertilizers applied in the form of ammonium sulphate (Aiyer, 1972). Some evidences indicated that the part of the nitrogen requirement for the rice crop (25-35%) could be met by using Cyanobacteria as biofertilizer (Rai *et al.*, 2000). *Cyanophyceae* are almost universal in distribution but their fluctuation and abundance depend upon their surrounding environment. A few studies have been made on the fresh water *Cyanophytes* in India (Talukdar, 1997; Sing, 1985; Kaushik, 1987; Tiwari and Chauhan, 2006*;* Sridhar *et al*., 2006; Tas and Gonulol, 2007; Santhilkumar and Sivakumar, 2008; Laskar and Gupta, 2009). Taxonomic study of *Chroocophyceae* (Cyanophyta) was carried out (Ghose, 1927 b). The present study aims to provide information on the taxonomy of *Chroococcales* (Cyanophyta) was recorded for the first time from Goalpara district.

Study area :

Goalpara district is located on the southern part of the river Brahmaputra having a large area of wet lands and many other ecologically attractive spots of the globe. Goalpara district is located approximately 25^0 33/ to 26^0 12/ N latitude and 90^0 7/ to 91^0 5/ E longitude. The climate is hot and humid in summer and dry cool season in winter. On the basis of temperature and rain fall the season of the place is divided mainly to winter, pre-monsoon, monsoon and post-monsoon. The maximum atmospheric temperature may rises up to 32^0C

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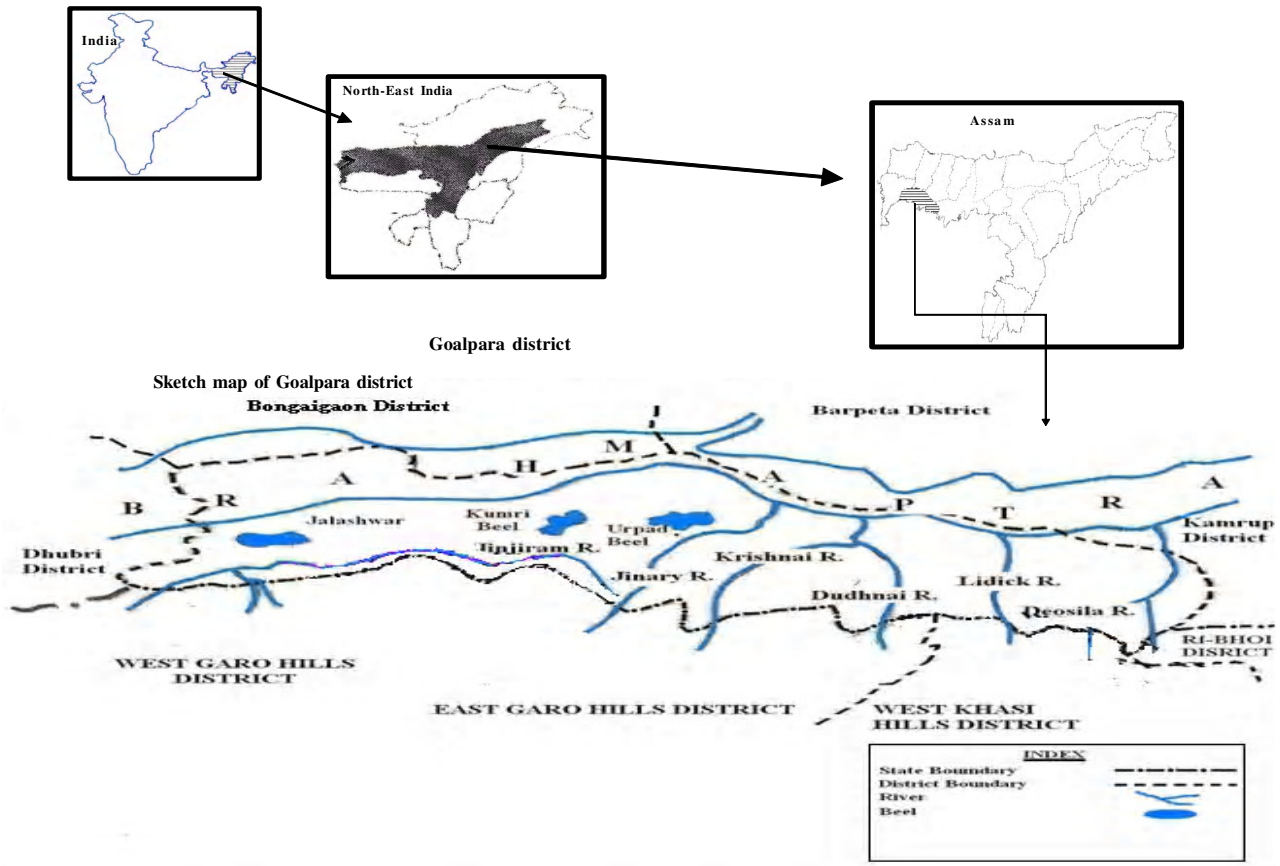

Fig. 1 : Locational map of study area

in August and minimum temperature falls upto 14 ^{0}C in January. Relative humidity (RH %) during summer is 91.2 per cent in day time and 75.2 per cent in night and in winter months it is 51.1 per cent at day and 35.5 per cent at night. The maximum rain fall was 556.1 mm in August and in November, December there was no rainfall.

MATERIALS AND METHODS

The blue-green algal samples were collected at monthly intervals from January 2007 to December 2010 from different spots of Goalpara district, Assam. These strains were culture with the help of Algal Broth Culture and Chu-10 media for isolation. The samples were identified using Olympus MLX-TR trinocular photomicroscope and compared with that of (Desikachary, 1959; Desikachary, 1987; Anand, 1998; Kemdirim, 2001; Prescott, 1964). Mostly blue-green algal samples were collected using planktonic net (mesh size 5µm). All the samples were preserved in 4 per cent formalin solution.

Water samples were collected from the study site during January 2007 to December 2010. Monthly samples of sub-surface water were collected during first week of month in the early hour of the day (7 to 9 a.m.). The months were arranged in season wise pre-monsoon (March-May), monsoon (June-August), post-monsoon (September-November) and winter (December-February). Water quality parameters like water temperature, pH, dissolve oxygen (DO), biological oxygen demand (BOD) were analysed as per the standard methods (APHA, 2005). Data obtained were compiled to get mean and standard deviation (Gupta, 2000).

RESULTS AND DISCUSSION

A total of fifty seven (57) species of phytoplanktonic, blue green algae identified belonged to order *Chroococcales*, family *Chroococaceae* and *Entophysalidaceae* among the identified twelve genera, *Gomphospheria* 1.75 per cent and *Chlorogloea* 1.75 per cent were represented by single species, *Coelosphaerium* 3.50 per cent, *Dactylococoopsis* 3.50 per cent and *Synechocystis* 3.50 per cent , by two, *Merismopodia* 5.26 per cent and *Gloeothece* 5.26 per cent by three, *Aphanothece* 7.01 *per cent* by four, *Microcystis* 12.28 per cent by seven, *Aphanocapsa* 14.03 per cent by eight, *Chroococcus* 15.78 per cent by nine and *Gloeocapsa* 26.31 per cent exhibited the largest-diversity with fifteen species. The growth of *Chroocophyceae* was most abundant in the aquatic environment especially in Planktonic state in terrestrial environment in benthic condition observed previously (Forti,

Table 1 : Seasonal variation of blue-green algae under *Chroococales, goalpara* district, Assam

Name	Seasons			
	Pre-monsoon	Monsoon	Post-monsoon	Winter
Division: Cyanophyta				
Class: Cyanophyceae Sachs.				
Order: Chroococcales Wettstein.				
Family: Chroococaceae Nägeli.			++++	+++
Aphanocapsa biformis A.Br.	++	++	++++	+++
Aphanocapsa grevillei (Hass.) Rabenh.	++	++	++++	+++
Aphanocapsa virescens (Hass.) Rabenh.	++	++	++++	+++
Aphanocapsa pulchra (Kütz.) Rabenh.	++	++	++++	+++
Aphanocapsa banaresensis Bharadwaja.	++	++	++++	+++
Aphanocapsa koordersi Strom.	++	++	++++	+++
Aphanocapsa crassa Ghose.	++	++	++++	+++
Aphanocapsa littoralis Hansg.	++	++	++++	+++
Aphanothece stagnina (Spreng.) A. Br.	++	++	++++	+++
Aphanothece microscopic Näg.	++	++	++++	+++
Aphanothece saxicola Näg.	++	++	++++	+++
Aphanothece naegelii Wartm.	++	++	++++	+++
Chroococcus cohaerens (Bréb.) Näg.	++	++	++++	+++
Chroococcus minutes (Kütz.) Näg.	++	++	++++	+++
Chroococcus giganteus West. W.	++	++	++++	+++
Chroococcus turgidus (Kütz.) Näg.	++	++	++++	+++
Chroococcus montanus var. *hyalinus* Rao, C.B.	++	++	++++	+++
Chroococcus turgidus var. *maximus* Nygaard.	++	++	++++	+++
Chroococcus tenax (Kirchn.) Hieron.	++	++	++++	+++
Chroococcus macrococcus (Kütz.) Rabenh.	++	++	++++	+++
Chroococcus varius A. Br.	++	++	++++	+++
Coelosphaerium kuetzingianum Näg.	++	++	++++	+++
Coelosphaerium dubium Grunow.	++	++	++++	+++
Dactylococcopsis fascicularis Lemm.	++	++	++++	+++
Dactylococcopsis raphidioides Hansg.	++	++	++++	+++
Gloeocapsa decorticans (A.Br.) Richter.	++	+++	++++	+++
Gloeocapsa crepidinum Thuret.	++	++	++++	+++
Gloeocapsa punctata Näg.	++	++	++++	+++
Gloeocapsa kuetzingiana Näg.	++	++	++++	+++
Gloeocapsa pleurocapsoides Novacek.	++	++	++++	+++
Gloeocapsa calcarea Tilden.	++	++	++++	+++
Gloeocapsa atrata (Turp.) Kütz.	++	++	++++	+++
Gloeocapsa granosa (Berk.) Kütz.	++	++	++++	+++
Gloeocapsa coracina Kütz.	++	++	++++	+++
Gloeocapsa magma (Bréb.) Kütz.	++	++	++++	+++
Gloeocapsa montana Kütz.	++	++	++++	+++
Gloeocapsa nigrescens Näg.	++	++	++++	+++
Gloeocapsa polydermatica Kütz.	++	++	++++	+++

Table 1 : Contd….

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Gloeocapsa steegophila v. *crassa* Rao. C. B.	++	++	++++	+++
Gloeocapsa gelatinosa Kütz.	++	++	++++	+++
Gloeothece samoensis Wille.	++	++	++++	+++
Gloeothece samoensis var. *major* Wille.	++	++	++++	+++
Gloeothece rhodochlamys Skuja.	++	++	++++	+++
Gomphosphaeria aponina Kütz.	++	++	++++	+++
Microcystis flos-aquae (Wittr.) Kirchn.	++	++	++++	+++
Microcystis bengalensis Banerji.	++	++	++++	+++
Microcystis robusta (Clark.) Nygaard.	++	++	++++	+++
Microcystis elabens (Bréb.) Kütz.	++	++	++++	+++
Microcystis lamelliformis Holsinger.	++	++	++++	+++
Microcystis aeruginosa Kütz.	++	++	++++	+++
Microcystis elongata Rao, C. B.	++	++	++++	+++
Merismopedia punctata Meyen.	++	++	++++	+++
Merismopedia minima Beck.	++	++	++++	+++
Merismopedia tenuissima Lamm.	++	++	++++	+++
Synechocystis pevalekii Ercegovic.	++	++	++++	+++
Synechocystis aquatilis Sauv.	++	++	++++	+++
Family: Entophysalidaceae Geitler.	++	++	++++	+++
Chlorogloea microcystoides Geitler.	++	++	++++	+++

N.B. +++++ = dominant, ++++ = abundant, +++ = frequent, ++ = occasional, + = not found

Table 2 : Physico-chemical charecteristics of water of Urpod beel, Goalpara deitrict, during January 2009 to December 2009

Parameters	Post-monsoon (Mean ± SD)	Winter (Mean ± SD)	Pre-monsoon (Mean ± SD)	Monsoon (Mean ± SD)
Water temperature (°C)	24.4 ± 0.0	18 ± 1.15	26.2 ± 0.1	33.9 ± 0.0
pH	7.1 ± 0.0	6.7 ± 0.0	5.9 ± 0.0	6.6 ± 0.0
Dissolve oxygen (DO) mg l^{-1}	6.1 ± 4.3	7.26 ± 0.4	5.2 ± 2.82	3.9 ± 0.06
Biologica oxygen demand (BOD) mg l^{-1}	7.1 ± 1.2	7.8 ± 0.3	8.2 ± 0.9	13.8 ± 0.6

1907). The temperature is considered to an important factor in the periodicity of *Chroococcales*. *Chroococcales* were found to be abundant during summer when temperature was high. A great temperature range 18-31^{0}C was found to be favorable for growth of *Chroococcales*. The *Chroococcales* were found abundantly in post-monsoon season where *Microcystis flos-aquae*, *Microcystis lamelliformis, Microcystis aeruginosa* were dominant. In winter it was frequent and pre-monsoon and monsoon season it was occasionally found. In aquatic habitat of the study area *Microcystis aeruginosa,* one of the most dominant species was found through out the study period and its blooming period was summer. According to Pawar *et al*. (2006) reported the maximum algal population during summer, medium during winter and minimum during monsoon season. The enumerated algal species are showing plate no. A and B.

The physico-chemical properties of water (Table 2) showed that the dissolved oxygen values ranged from 3.9 to 7.26 mg l^{-1} and BOD (Biological Oxygen Demand) fluctuated between 7.1to 13.8 mg l^{-1}. The highest DO was recorded in the winter 7.26 mg l^{-1} followed by post-monsoon, pre-monsoon and monsoon. Water temperature was maximum in monsoon 33.9^{0}C and minimum in winter 18^0 C. The dissolved oxygen and rainfall have their significant relationship with each other. The maximum dissolved oxygen during winter due to the fact that in lower temperature oxygen carrying capacity of water increases (Desai *et al*., 1995; Kosygin *et al*., 2007). The biological oxygen demand (BOD) shows maximum in monsoon 13.8 mg l^{-1} and minimum in post-monsoon 7.1 mg l^{-1}. During monsoon, surface runoff carries waste and sewage from the surrounding areas into the low-lying beds, thereby increasing the respiratory activity of the heterotrophic organisms (Singhal *et al*., 1986). The pH was maximum in post-monsoon 7.1 and minimum in pre-monsoon 5.2. The narrow range of pH(5.2–7.1) indicated stability as most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes

(George, 1997).

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