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Occurrence of *Microcystis aeruginosa* Kütz. water blooms in a eutrophic pond of Chidambaram taluk

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ABSTRACT

The occurrence and abundance of *Microcystis aeruginosa* were monitored monthly in eutrophic pond water of Ilamiyakkinar temple pond from July 2014 to June 2015. Some environmental factors such as water temperature, pH, free carbon-dioxide (FCO_2), total alkalinity, Dissolved oxygen (DO_2), biological oxygen demand (BOD), nitrate (NO_2-N) and phosphate are recorded and their relationship with the bloom formation by *Microcystis aeruginosa* were discussed. The initiation and persistence of *Microcystis aeruginosa* were founded to be triggered by relatively high water temperature (24 °C to 36.5 °C), pH (7.3 to 8.72) and NO_2-N concentration.

1. INTRODUCTION

Microcystis aeruginosa is one notorious genus forming water blooms, particularly in shallow eutrophic pond water environments and often cause serious problems in the management of water quality. Blue green algae needs warm temperature, light, phosphorus and nitrogen for its growth. Phosphorus and nitrogen is commonly found in animal and human waste and in fertilizers. Some common ways for phosphorus and nitrogen to enter into pond and lakes are from agriculture and garden run off, improperly functioning septic systems and erosion of nutrient rich soils (NALMS position statement, 2007). Eutrophication is the result of uncontrolled human population growth and the discharge of urban, industrial and agricultural effluents into the aquatic system of several countries (Tundisi and Matsumura, 1992). One of the major consequences of eutrophication is the appearance of cyanobacterial blooms (Azevedo *et al*., 2002). *Microcystis aeruginosa* is one of the most common species existent during cyanobacterial bloom, often occurs as large colonies with tens of thousands of cells under natural conditions. Colony formation plays an important role for the domination of this cyanobacterium in an aquatic system (Wu and Song, 2008).

Cyanobacterial blooms can cause a variety of water quality problems, including dissolved oxygen depletion and subsequent fish kills, aesthetic nuisances (eg. Increased bad odours, algal scum, fish tainting decreased aesthetic quality) and unpalatable, possibly even drinking water (Carmichael, 2001). A large number of *Microcystis* blooms containing toxic cyclic heptapeptide named microcystin are reported from various countries (Kardinaal and Visser, 2005).

Cyanobacteria are known to produce a variety of toxins (Microcystin) that can be lethal to livestock, pets, wildlife and humans following the ingestion of water contaminated with toxic cells or toxins released from decaying cells (Azevedo *et al*., 2002). Microcystin production of *Microcystis* is affected by a wide variety of physico-chemical factors, including temperature, light, nutrient concentration and others (Sivonen and Jones, 1999). Especially nitrogen and phosphorus are the important factors which control both the abundance of *Microcystis* and microcystin production (Sivonen and Jones, 1999). The current study deals with an abundance of *Microcystis aeruginosa* and the effect of various environmental factors that triggered the bloom of cyanobacteria in the eutrophic pond of Annamalai Nagar.

2. MATERIALS AND METHODS

2.1. Study area: The present study was carried out in eutrophic pond in Ilamiyakkinar temple pond Chidambaram taluk, Tamil Nadu, India from July 2014 to June 2015.

2.2. Analysis of water quality: Surface water samples were collected once a month from 10 to11 am. Water samples were collected in black plastic bottles for the estimation of different physico-chemical parameters. The surface water temperature was measured using a Celsius thermometer. The pH of water sample was measured with the help of pH meter (Elico LI-1617) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0 and 7.0. Dissolved oxygen is determined by dissolved oxygen analyzer (Elico PE-135). Rest of the physico-chemical properties like total alkalinity, free carbon dioxide, BOD, nitrate and phosphate were analysed in laboratory following APHA (2012).

2.3. Analysis of *Microcystis* species: Plankton samples were collected from plankton net of 20µm (no.30) mesh size and preserved in 5% formalin. For the enumeration of phytoplankton a 300 ml of a water sample was fixed with lugol's solution at a final concentration of 1% phytoplankton were concentrated by natural sedimentation and cell numbers of each species were counted with a haemocytometer under microscope at Nikon Eclipse light microscope. *Microcystis* species was identified based on their morphology (Komarek, 1991).

3. RESULTS AND DISCUSSION

During the study period cyanobacterial bloom was observed in the month of July 2014 to June 2015. Cyanobacterial cell density was highest (85×10^6 cells/L) in May. *Microcystis aeruginosa* predominated in June.

3.1. Physico-chemical parameters

All the physico-chemical parameters were found to vary in different months (Figure 1). Water temperature was found to increase from February and the increasing trend continued till June. Seasonal changing pattern of pH was similar to that of water temperature ranging between 7.3 to 8.72. DO was lowest in May and started to increase to highest level in December. Highest FCO_2 was observed in May and lowest amount in November. BOD was lowest in December and highest levels in May. Nitrate (NO_2-N) was highest in May and lowest level in December. Phosphate was lowest in November and highest in May. Total alkalinity was highest present in May and lowest in December. Physico-chemical parameters like pH, dissolved oxygen, phosphate, nitrate, total alkalinity and BOD may have influenced the growth of Cyanophyceae (Elayaraj and Selvaraju, 2014).

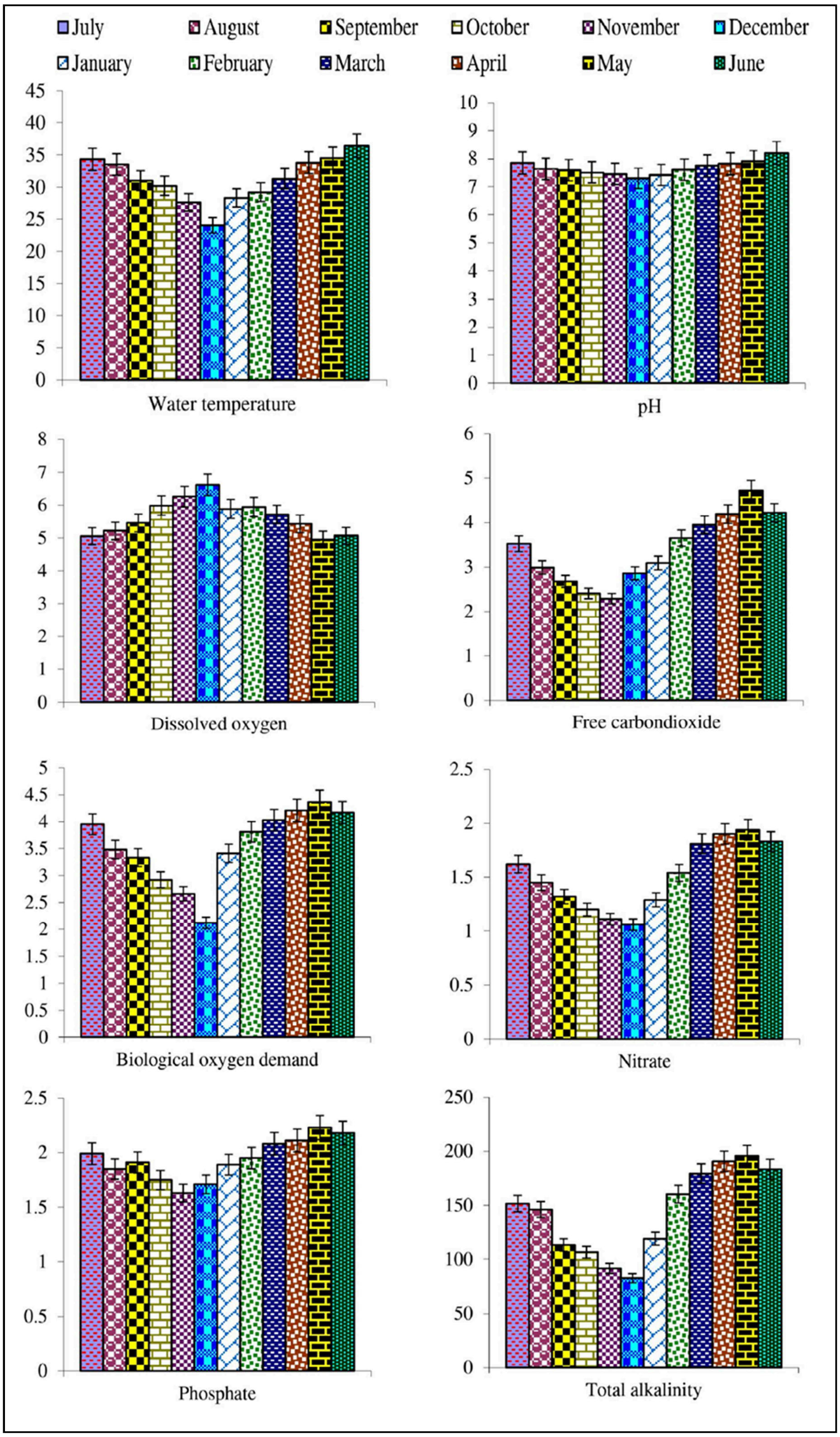

Figure 1. Monthly variations of Physico-chemical Parameters of ilamiyakkinar temple pond during July-2014 to June-2015

3.2. Occurrence of *Microcystis aeruginosa* Kütz.

Relatively higher density of *Microcystis aeruginosa* in pond was due to fact that pond received sewage wastes from drains that were found to bring large amount of nutrients into the pond. Relatively high temperature created more favourable conditions for the growth of cyanophyceae in May. Tilman *et al*. (1986) reported that *Microcystis* species have shown dominance at temperature higher than 20 °C which agrees with the findings of the present study. Alkalinity, pH, low DO, high BOD and high nutrient concentration were observed during the bloom periods in the pond. The coincidence of cyanophyceae bloom with relatively higher temperature, pH and nutrient concentration levels high in summer was observed in the present study agree with the findings of Affan *et al*. (2005). Jewel *et al*. (2006) reported that *Microcystis* species was found to be controlled by relatively high temperature (> 25 °C) and nutrient enrichment, especially high nitrogen concentration. Utkilen *et al*. (1996) reported that *Microcystis* species population collapsed when concentration decreased. Eloff and Vander (1981) reported that *Microcystis* grew well at temperature 27 °C to 29 °C in culture condition at pH values between 6.5 to 10.5. Quadra *et al*. (1998) reported 95% of *Microcystis aeruginosa* in a cyanobacterial bloom in a eutrophic Lall Takerkousta reservoir in Morocco.

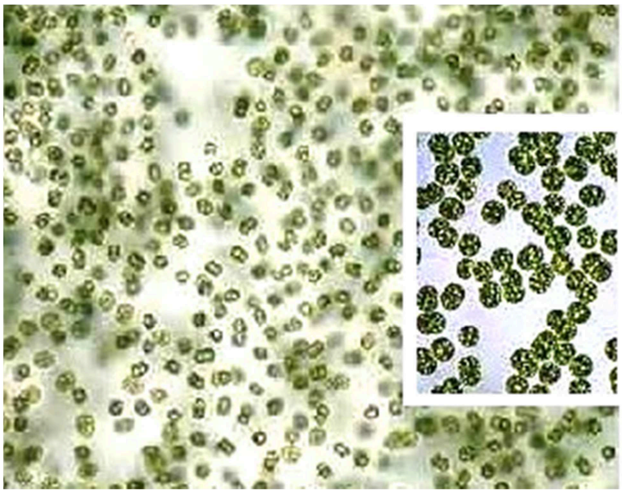

Figure 2 Photograph of Dominant algae *Microcystis aeruginosa* Kütz

In the present study, we have analysed that temperature is one of the important environmental factors determining dominant *Microcystis* species (Figure 2). This result suggests that the dominance of *Microcystis aeruginosa* occurs in eutrophication pond water ecosystems more frequently under global warming. Park *et al*. (1998) reported that higher amount of toxin was released from *Microcystis* cells when the water temperature was high, due to the dominance of toxic *Microcystis aeruginosa*. Hence, toxic effects by *Microcystis* may become more serious in temperature eutrophic pond water ecosystems under global warming. The physico-chemical changes in the water may accept particular species and include the growth and abundance of other species which lead to succession. Low diversity of cyanobacteria was attributed to massive blooms of *Microcystis aeruginosa* in eutrophic ponds (Elayaraj and Selvaraju, 2014).

4. CONCLUSION

For the present study, *Microcystis* is one of the predominant life form in the present Eutrophic pond water system. It is recommended that further investigation of *Microcystis aeruginosa* in connection to natural variables and also their harmful and poisonous impacts ought to be attempted in diverse ponds, lakes, rivers and pools of Tamil Nadu.

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