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DIRECT EFFECTS OF PHOSPHATES CONCENTRATION ON THE MICROALGAL GROWTH IN MALAKAND PAKISTAN

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ABSTRACT

Microalgal growth can be effected by different environmental factors, most important of them is, the nutrient of the specific habitat. Among nutrients, total phosphate (TP) has a remarkable contribution in microalgal growth and their diversity. In our study, TP values were determined for different water bodies of district Malakand, Pakistan and their effects were correlated with the algal growth and diversity. The explored locations were divided into different water bodies and observed with lowest TP value of 0.6 mg/L and highest 3.5 mg/L for stagnant water. Similarly, the running water ranged between 0.1 and 1.7 mg/L while waste water was found to be highest value for TP, where the lowest value was 3.1 mg/L and highest was 5 mg/L. The highest amount of TP was observed in waste water bodies which were dominated by algal blooms, especially, during summer season. There was a sufficient change in the TP values before and after development of algal bloom. The amount of algal bloom with high concentrations of TP showed that it affects the diversity of microalgae and a few resistant varieties could develop into algal bloom.

Key words: Diversity, microalgae, nutrients, total phosphates.

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INTRODUCTION

Total phosphates have a very important role in growth of microalgae. The amount of total phosphates determined the growth of microalgae in a particular water body. The amount of total phosphates is determined by the accumulation of calcium and increase in pH which results in formation of calcium phosphates (Moutin *et al*., 1992). This could also account for the algal bloom in ponds. When the amount of TP is less than 5 µg/L in a system, its increase or decrease in this range results in a very little change in algal biomass. As the amount of TP exceeds this amount, the algal biomass increases rapidly in range

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of 6-65 µg/L and a dramatic increase occurs when the amount of TP exceeds 65 µg/L, so there exists a sigmoid relationship between algae biomass and TP (Watson et al., 1992). Increase in temperature could enhance the phosphate accumulation ability of the microalgae (Powell *et al*., 2008).

Algae are very important group of organisms and can affect human life both positively and negatively. Algae are good source of food and energy. Among them the unicellular algae have a major contribution as food source (Geoghegan, 1951). Chlorella is a rich source of nutrients for chicks (Combs, 1952) and algae particularly blue-green algae are most useful organisms to fix atmospheric nitrogen(Allison and Morris, 1930). Nitrogen fixing blue-green algae have a positive effect on the growth of rice (Watanabe *et al*., 1951). Certain algae help in utilization of nitrogenous organic compounds and sodium salts of organic acids like some of the soil inhabiting algae (Skinner and Gardner, 1930), amino acids (Fowden, 1951) like lysine and threonine (Hundley *et al.*, 1956) and a new amino acid gigartinien(Ito and Hashimoto, 1966), citric acids (Creac'H, 1952), ascorbic acids (Creac'H and Baraud, 1954) and arginine in free and combined form (Dokhan, 1953). Enzymes like oxidase, transoxidase(Yamafuji *et al.*, 1954) and aldolase(Van-Baalen, 1965) can be obtained from different kinds of algae. Both freshwater and marine water algae are rich sources of vitamins like vitamin B12 (Hashimoto, 1954), B-complex vitamins (Teeri and Bieber, 1958). Some red algae are the best source of cholesterol (Tsuda *et al.*, 1957) and a source of commercial fertilizers, especially, the freshwater inhabiting algae (Rice, 1946). The algae can also produce nitrites and formaldehyde which can be used for commercial purposes (Sommer, 1936). Gibberellins like compounds (Mowat, 1963) and auxins(Overbeek, 1940), plant growth hormones can be obtained from certain marine algae. *Stichococcusbacillaris,* an algacontains antibiotic substances against certain notorious pathogens causing human disease (Harder and Oppermann, 1953). Algae are a powerful biological tool for sewage treatment (Bogan, 1961).

MATERIALS AND METHODS

To investigate algae species and the various growth parameters in the research area, various sites were selected from district Malakand on the basis of adequate water bodies present. These sampling sites were based on the kind of water i.e. stagnant/running, number of water bodies, profundity of water bodies, seasonality, contamination and turbidity of water bodies. The main sites selected for current work were Thana, Batkhela, Malakand, Dargai and

Shergarh areas of district Malakand. Sample collection was done from various water bodies of these five major areas.

Total Phosphate of water was determined according to Hach DR 5000 Spectrophotometer Manual (Hach, 2008). Diversity of algal flora samples were collected and preserved in 4% formalin. Algal identification was made using inverted electric microscope (BH-2 Olympus, Japan). Photomicrographs were taken with camera LetizWetzlar

RESULTS AND DISCUSSION

Among the five major areas selected for total phosphates analysis, the area Thana was observed with lowest TP as 1.4 mg/L and highest 3 mg/L for stagnant water. Similarly, the running water ranged between 0.1 and 0.7 mg/L while waste water was found to be highest with the lowest as 3.1 mg/L and highest as 4.8 mg/L. The other area Batkhela showed close comparison with Thana in range of TP. The lowest value recorded for stagnant water was 1.2 mg/L and highest was 3.4 mg/L while for running water the TP values recorded were in the range of 0.1 – 1.7 mg/L. Similarly, the waste water showed a higher amount of TP ranging from 3.5 mg/L in December to 5.6 mg/L in the month of February.

The next area Malakand was also analyzed for TP considering three habitats i.e. stagnant, running and waste waters. The TP value recorded for stagnant water was 0.7 – 2.5 mg/L. The lowest value recorded for stagnant water was in the month of January while highest was September. On the other hand, the values recorded for running water were ranging from 0.3 to 0.8 mg/L. A very slight variation was observed in the TP value for running water in respect to different seasons of the year. The waste water bodies studied for this area have TP value in range of 3.4-5 mg/L with lowest data recorded in the month of October while highest in the month of May.

The research area, Dargai, has TP values ranging between 1.3 and 2.7mg/L for stagnant water, 0.2 and 1 m/L for running water and 3.8 -4.9 mg/L for wastewater bodies. A very little variation was observed in the TP values of these research spots. The area of Shergarh was also divided in to three main water bodies. The TP value recorded for stagnant water ranged between 0.6 mg/L in month of January to 3.5 mg/L in the month of September. Similarly, the TP recorded for running water was 0.3 to 1.15mg/L while that of waste water was 3.8-4.7mg/L. The variation in TP in respect to season was very less in running and wastewater studied for this location.

The total phosphates of different water bodies in research field were studied with respect to algal variation and biomass. The highest amount of phosphates was observed in waste water bodies which were

dominated by algal blooms especially during summer season. There was a sufficient change in the amount of phosphate before and after development of algal bloom (Fig. 3). Certain wild algae, like chlorella sp, could assimilate up to 75% of the total phosphates grown in media under laboratory conditions (Wang *et al*., 2010). Similarly, another microalgal species *Auxenochlorellaprotheocoides* could uptake total phosphates up to 81% when grown in highly concentrated waste water (Zhou *et al.*, 2012).

The areas which were dominated by a variety of microalgae i.e., stagnant water had sufficient amount of TP (Fig. 3). Due to warm temperature, more dissolved form of total phosphates existed in the stagnant water in summer season and this favored the existence of a large variety of microalgae in these systems.

The running water which was deficient in total phosphates was reported to be having a very little variation in species composition. The species found there may be those which can grow in deficiency of TP as well.

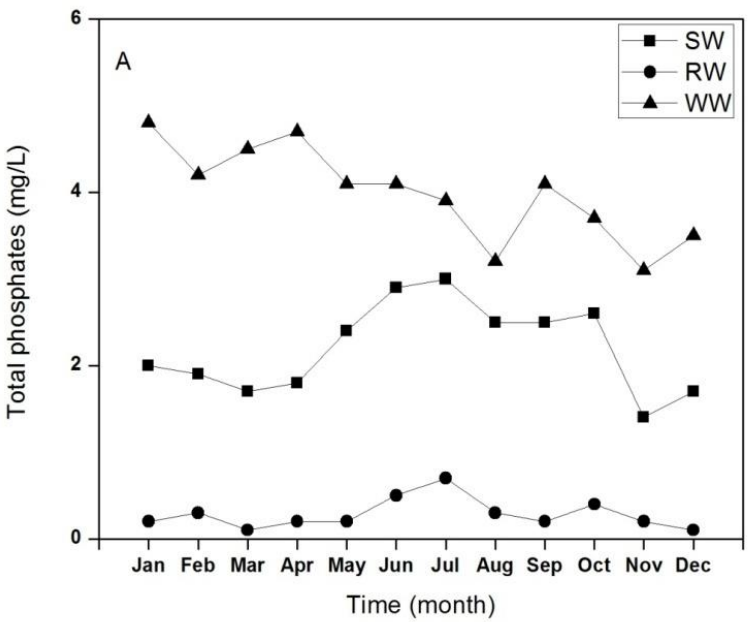

Figure 01: Monthly variation in total Phosphates (TP) in research location of Thana

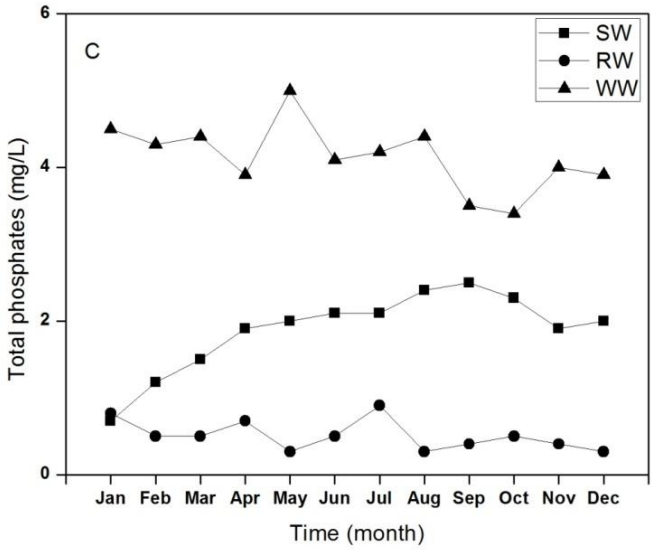

Figure 03: Monthly TP variation in research location of Malakand

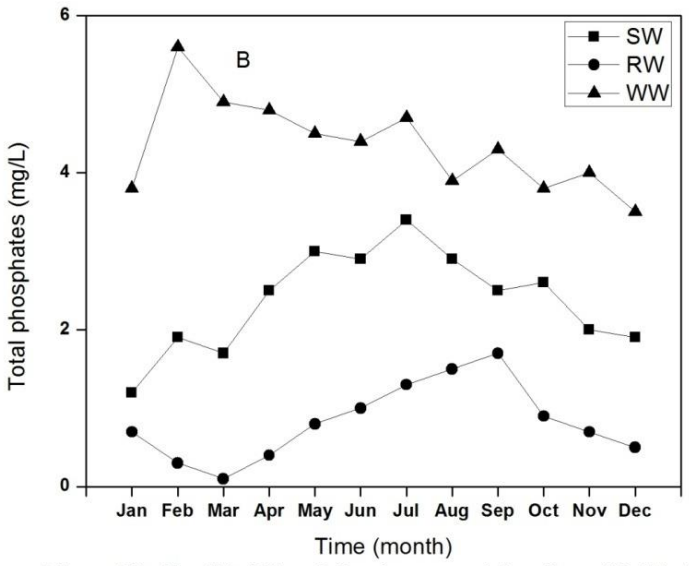

Figure 02: Monthly TP variation in research location of Batkhela

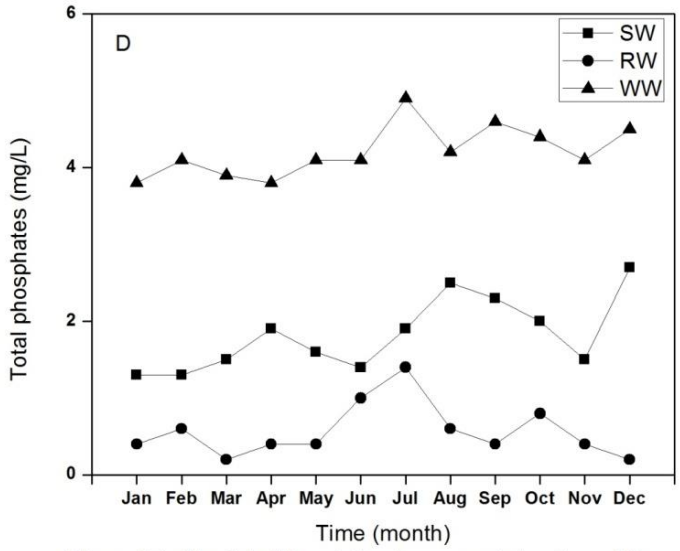

Figure 04: Monthly TP variation in research location of Dargai

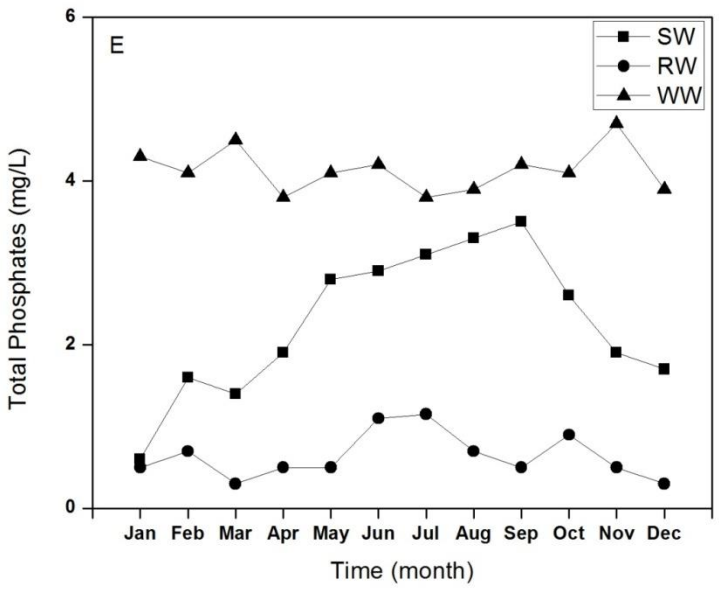

Figure 05: Monthly TP variation in research location of Shergarh

CONCLUSION

Total phosphate has a remarkable contribution in the growth of micro-algae and their diversity as well. The highest amount of total phosphate was found in waste water bodies which were dominated by algal blooms, especially during summer season. There was a sufficient change in the TP values before and after development of algal bloom. Consequently, the high concentrations of algal bloom affected the diversity of microalgae.

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