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Influence of Nutrient on Growth of Some Freshwater Algae of Vena River in Hinganghat Area of Dist. Wardha

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Abstract: ***The present study reports on influence of nutrient on growth of freshwater algal taxa of Vena River in Hinganghat area of Wardha District. The algal taxa like Oscillatoria, Chloroccocum, Selenastrum and Coelastrum were studied and reported influence of Carbon, Nitrogen, Phosphorous, Magnesium, Potassium, Chloride and Iron from June 2011 to May 2013.***

Keywords: Algae; Aquatic ecosystem; Eutrophication; Vena river

1. Introduction

The present research enables to know the influence of nutrient on growth of freshwater algal taxa of Vena river in Hinganghat area of Wardha District, which is a part of Vidarbha, Maharashtra state. The study was made over a period of two years of intensive study i.e. June 2011 to May 2013. It has been investigated by Marathe, (1969) and Jawale and Chaudhari, (2010) that algae occurs in sufficient quantities to render its commercial applications.

Hinganghat is one of the tehsils of Wardha District situated in $20^0$18' to 20^0 49' N and $78^0$32' to $79^0$14' E latitude. The town is located on the bank of river Vena, a tributary of the Wardha river which joins the big river Pranhita ahead at a distant place, which ultimately merges into the Godavari river later. In British India, Hinganghat was the centre of India, but after the partition of Hindusthan into India, and Pakistan, Nagpur is considered as the center (heart place) of India. At Vena river pump house, there is a historical old stone, on which it is mentioned that Hinganghat is the centre of India. Major portion of the total annual rainfall is received from the months of June to September of every year. The average rainfall of Hinganghat Tahsil is 1071.70 mm, and has a dry tropical weather climate. The climate is hot, and dry. Max temp. in ^{0}C is noted as 47.9 ^{0}C and Min. temp. in ^{0}C is noted as 10.2 ^{0}C. The seasons of a year are divided according climates into three namely cold, hot and monsoon. The land scape of the city with fast running streams faces towards the south. Vena River borders the north, west, and south sides of the city. The city is rich in fauna, and flora and water sources. In Hinganghat area, Vena river is a fresh water body, and is one of the prominent rivers of Vidarbha, Maharashtra. It is Perennial River of this area. It is supposed to be the life line of the Wardha district, but due to expanding needs of growing population, it is facing many adversities or changes. The river Vena has received little attention from botanists, ecologists and specially phycologist as such and moreover, the scientific approach has not been holistic. The study of influence of nutrient on growth of freshwater algal taxa of this river is of great importance, and should be known to the peoples, and may be the heritage of future generation.

2. Materials and Methods

Vena River is one of the major water bodies of Hinganghat region in Wardha District, Vidarbha. Stations SW1 (Underbridge), SW2 (Kawalghat), SW3 (Smashanbhoomi), and SW4 (Shahalangadi) were selected near Hinganghat area. Water samples were collected from June 2011 to May 2013. These samples were analysed for determining the algal taxa. The macroscopic algae were manually picked with forceps and microscopic algae with the help of a planktonic net (pore size less than 40 µm). The samples were immediately brought to the laboratory for the taxonomical documentation of algal taxa and preserved in 4% formalin for reference purpose. Preserved samples were studied after the proper settlement of the algal debris. The samples were examined under binocular microscope with attached MIPS for the identification of algal groups and photographs were taken. Algal identification was carried out with the help of available taxonomic literature.

3. Observations

Influence of Carbon (mg/l) on algal growth

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
1	27	1.303	1.21	1.248
2	29	1.323	1.22	1.289
2.266	28	1.374	1.298	1.263
4	26	1.31	1.021	1.107
8	27	1.108	1.2	1.028
12	22	1.028	0.932	0.942
16	21	1.026	0.913	0.931

Influence of Nitrogen (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
200	25	1.592	1.501	1.682
242	22	1.602	1.5	1.598
250	25	1.604	1.522	1.684
300	28	1.611	1.599	1.701
350	22	1.503	1.41	1.68
400	19	1.59	1.51	1.675
450	20	1.541	1.44	1.638

Influence of Phosphorous (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
4	21	1.246	1.181	1.271
7.1	18	1.405	1.39	1.423
8	17	1.33	1.278	1.383
16	15	1.421	1.372	1.489
32	14	1.278	1.2	1.421
64	12	1.227	1.157	1.253
128	10	1.69	1.068	1.198

Influence of Magnessium (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
4	23	1.482	1.435	1.512
7.3	26	1.605	1.525	1.64
8	29	1.55	1.509	1.586
16	25	1.588	1.579	1.721
32	23	1.703	1.528	1.623
64	21	1.698	1.528	1.737
128	18	1.233	1.539	1.5

Influence of Potassium (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
4	29	1.307	1.279	1.34
8	17	1.405	1.38	1.423
16	21	0.99	1.374	1.427
17.95	23	1.39	1.369	1.421
32	14	1.426	1.401	1.42
64	13	1.41	1.393	1.441
128	9	1.4	1.373	1.425

Influence of Chloride (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
4	23	1.397	1.309	1.482
8	24	1.425	1.345	1.537
16	28	1.432	1.343	1.535
23.99	24	1.403	1.318	1.492
32	23	1.438	1.35	1.551
64	21	1.41	1.325	1.506
128	18	1.341	1.253	1.44

Influence of Iron (mg/l) on algal growth.

Concentration in mg/l	*Oscillatoria*	*Chloroccocum*	*Selenastrum*	*Coelastrum*
0.2	24	1.72	1.58	1.75
1.20	28	1.737	1.598	1.805
2	22	1.7	1.591	1.8
4	21	1.32	1.231	1.421
8	18	1.29	1.582	1.41
16	16	1.24	1.18	1.441

4. Result

In this investigation the maximum growth of *Chloroccocum humicalum* and *Selenastrum westii* was recorded as same in concentration of carbonate which is one of the components of basal medium. The maximum growth of *Chloroccocum humicalum* and *Oscillatoria amphibia* was observed at 300 mg/l of nitrogen.

In present investigation it is found that the magnesium requirement of *Chlorococcum humicolum* is 32.00 mg/l, *Oscillatoria amphibia* 8 mg/l, *Selastrum sps* 16 mg/l and *Coelastrum sphaericum* 64 mg/l. Many workers reported maximum growth of algae at various levels. The tolerance of *Chlorella vulgaris* is high in high concentration of Mg salt and it grows considerably over in 0.42 moles mg/l as recorded by Trelease and Selsam,(1939).

The results of investigation in accordance with Sharon and Belinger, 1976 who noted optimum uptake occurs at about 8 mg/l and lower concentration of $MgSO_4$ inhibit growth of algae.

In the present study maximum growth of *Chloroccoum humicolum* and *Selenastrum westii* is found at 32 mg/l and *Oscillatoria amphibia* at 4 mg/l and *Coelastrum sphaericum* at 64 mg/l. The result is similar to *Chlorella vulgaris* at 2 mg/l of potassium.

In this study, 32 mg/l chloride is require for maximum growth of *Chloroccoum humicolum*, *Selenastrum westii* and *Coelastrum sphaericum*.

In present investigation 1.20 mg/l iron which is equal to iron in basal medium is required for *Chlorococcum sphaericum*. The optimum amount of iron required for growth depends upon species as well as on the composition of media concentration the ideal concentration of 1.8×10^{-7} M to 2.6×10^{-8} M was found adequate for the growth of *Chlorella* (Myers,1944; Hopkins,1930); for the heterotrophic growth of *Chlorella pyrenoidosa* was found to be 1×10^{-9} M while for autotrophic growth it is 1.8×10^{-5} (Esyter, 1962).

5. Discussion

The major nutrients for plants are C, N, P, H, O_2 and they form the basis of energy metabolism and synthesis of macronutrients on phytoplankton. Silicon is needed for diatom to build cell walls. Sulphur is essential for protein production by phytoplankton. These elements are required in large amounts and hence they are known as major elements. Minor elements are those required in trace amount that include zinc, iron, manganese, cupper.

In this investigation the relative amounts and concentrations of major nutrients, nitrogen source, micronutrients composition are taken into consideration for maximum growth of algae.

Carbon: Carbon is a constituent of all organic compound protoplasm. It is derived from CO_2 carbonates, bicarbonates or organic compounds. The most common method of estimation of carbon absorption in algae is through

photosynthesis. Infact investigators depicted role of bicarbonate and CO_2 for *Spirullina, Chlorella*, marine diatoms *Phaecodyctulum tricoruntum* (Richmond *et. al*, 1982), Dixon and Merrett, (1988); CO_2 is only carbon compound which support growth. The amount of CO_2 bicarbonate and carbonate ions present in the medium is in equilibrium. Carbon was 2.266 mg/l in medium. The concentration of carbon selected to find its influence on algal growth in BG11 were 1,2,4,8,12,16 mg/l.

The growth of *Chlorococum humicolum* and *Selenastrum wastii* is maximum in 2.26 mg/l as equal to carbon in basal medium and growth of *Oscillotaria amphibian* and *Coelastrum spharicum* is obtained in 2.00 mg/l.

Nitrogen: Nitrogen is one of important constituent of many compounds involved in plant material. It is an essential part of living cells. It becomes limiting factors for growth of algae. The plants are utilized NO_3, NO_2 and NH_4 as Nitrogen source. In some flagellates especially Euglenoids NO_3 and NO_2 are not much essential as nitrate. It becomes toxic at higher concentration.

The normal requirement of Nitrogen in cultures of various species of green algae observed by Ketchum and Redfied, (1949), is about 6.5 -8.3% of ash free dry weight. Number of workers reported concentration of Nitrogen required for maximum growth of algae. Rodhe, (1948), Chu, (1942), and Gerloff *et al*., (1950), reported low concentration of Nitrogen 10.2, 13.6 mg/l respectively where as Tanda, (1951), Scott, (1944) Mayers and Clark, (1944), Craig *et al.,* (1937), and Geoghegen, (1953), reported higher requirement that is 87, 106, 350, 305 mg/l of nitrogen respectively.

The growth rate in case of *Closterium* and *Nitzschia* are independent of nitrate -Nitrogen concentration between 0.005-0.5 mg/l was reported by Ketchum, 1939.

The influence of N on algal growth in test experiments, the range of 200-400 mg/l as against normal Nitrogen 247.48 mg/l in BG-11 medium. The maximum growth of *Chlorococum humicolum, Oscillotaria amphibian, Selenastrum wastii,* and *Coelastrum spharicum* is observed in 300 mg/l concentration of nitrogen.

Phosphorous: It is important constituents of ATP which plays vital role in energy metabolism of cell. It is involve in metabolism of plants. It is major constituent in algae for normal growth (Myers, 1951; Ketchum, 1954, Krauss, 1958, Provasoli, 1960). The phosphorous requirement for optimum algal growth differs from species to species. Higher concentration of phosphorous inhibit the growth (Chu, 1942) In this investigation phosphorous requirement for *Oscillatoria amphibia* and selanastrum wastii was 7.1 mg/l as equal to phosphorous in basal medium and *Chloroccoum humicolum* and *Coelastrum sps* is 16 mg/l.

Various researches reported different requirement of phosphorous Rodhe, (1948), Chu, (1942) Gerloff, *et al*., (1950), recorded low requirement of phosphorous in these media.Tanda, (1951), Scott, (1944) Myers and Clark, (1944), Craig *et al*., (1993), reported calcium is essential element for all chlorophyll containing plants.

Phosphate range is from 4.00 mg/l to 128 mg/l. The maximum growth of *Oscillatoria amphibia* and *Selenastrum wastii* were observed at 7.1 mg/l equal to phosphate in basal medium and maximum growth of *Chlorococum humicolum* and *Coelastrum spharicum* were observed at the concentration of 16 mg/l.

Magnesium: Magnesium is a component of chloroplast counter ion of ATP important for protein biosynthesis. Magnesium is needed by algae species because nearly all algae have chlorophyll. An adequate concentration of mg for algae may quite low of *Ankistrodesmus sp* 0.1 mg/l. The concentration of magnesium was 7.38 mg/l in basal medium. The elements concentrations taken were 4, 8, 16, 32 and 128 mg/l. The maximum growth of *Oscillatoria amphibian* obtained at the concentration of 8.00 mg/l. Maximum growth of *Chlorococum humicolum* were at 64 mg/l.

Potassium: It is required for all algae under deficient condition. It is major element in algae. The concentration of Potassium was 17.95 mg/l in basal medium. The elements concentrations taken were 4, 8, 16, 17.95, 32, 64 and 128 mg/l. The maximum growth of *Oscillatoria amphibian* obtained at the concentration of 17.95 mg/l as concentration of potassium in basal medium. *Chlorococum humicolum* is at 16 mg/l. *Selanastrum* at 32 mg/l and *Coelastrum* at 64 mg/l.

Chloride: It is essential for photosynthesis in algae.It is needed for Hill reactions ATP formation. FMN catalysed photophosphorylation reaction (Vernon, *et al.,* 1965) and 16 different requirement of chloride for Phytoplankton. Whitton and Shehata was reported different requirement of chloride for phytoplankton. Sliehata, and Whitton., (1982) reported 26.46 mg/l; Antarikanonda, (1982) indicated 139.6 mg/l chloride for Cyanophyceae. Whereas Guillard, (1973) noted 17.35 mg/l Chloride in medium for diatoms. In the experiment, Chloride with the range of 4.00 - 128.00 mg/l, the growth of *Chlorococum humicolum* and *Coelastrum spharicum* were maximum at 32.00 mg/l *Oscillatoria amphibian* showed maximum growth at 16.00 mg/l.

Iron: Iron is a key element in plant metabolism. The rate of photosynthesis is lowered by iron deficiency. The iron requirement in biological oxidation reduction applies to algae as well as to other living organisms. A direct correlation between photosynthetic activity and chlorophyll content was demonstrated in *Chlorella pyrinoidosa* by Emerson, (1929); who reported that reduced chlorophyll content is the only factor responsible for reduction of photosynthesis in iron deficient cells. Iron has been reported to be involved in nitrate reduction by *Chlorella*, (Trubochev *et al.,* 1976) and nitrate has been demonstrated in sub cellular preparation of *Anabaena cylindrica* (Hattori and Yesugi,1968). The level of iron is directly related to the next of hydrogen development in *Scenedesmus* (Yanagi and Saba, 1966).

The range of iron is 0.2 mg/l and 16.00 mg/l against 1.2 mg/l iron in BG-11, maximum growth of *Oscillatoria amphibian* and *Selenastrum wastii* and 2.00 mg/l and for *Chlorococcum humicolumn*, were the same in basal medium.

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