GROWTH KINETICS OF TWO DIATOMS *SKELETONEMA COSTATUM* AND *THALASSIOSIRA SP.* FROM IZMIR BAY (EASTERN AEGEAN SEA /TURKEY).

S. Kukrer [1], F. S. Sunlu [1]*, B. Buyukisik [1], H. Aydin [2] and U. Sunlu [1]
[1] Ege University Faculty of Fisheries Dept. of Hydrobiology - f.sanem.sunlu@ege.edu.tr
[2] Celal Bayar University, Fac. of Arts And Sciences, Muradiye, Manisa, Turkey

Abstract

The purpose of this research is to reveal the detailed information on growth kinetics of *Skeletonema costatum* and *Thalassiosira sp.* sampled from Izmir Bay. From the results of enrichment experiments under batch culture conditions it has been found out the limiting nutrinet for *Skeletonema costatum*is nitrate and for *Thalassiosira sp.* isreactive phosphate (RP).

Keywords: Aegean Sea, Phytoplankton, Nutrients, Growth, Eutrophication

Introduction

Primary production impetus is depending on the presence of nutrients in water column and their uptake rate by phytoplankton. The most important sources of nutrient enrichment in coastal waters are atmospheric deposition, enrichments from bottom waters and rivers as a point sources. Eutrophication is a process whereby water bodies, such as lakes, estuaries, or slow-moving streams receive excess nutrients that stimulate excessive plant growth (algae, periphyton attached algae, and nuisance plants weeds). This enhanced plant growth, often called an algal bloom, reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organisms to die. The understanding and preventing of europhication are depending on knowing the relationship between nutrients and phytoplankton.With the batch culture experiments carried out using the diatoms *Skeletonema costatum*and *Thalassiosira sp.* from Izmir Bay it was aimed to point out the physiological properties of this species. Additionally, to form a base for model studies by parameterise its exponential growth rates, nutrient limiting growth rates and the Michealis-Menten curves that indicate dependence on nutrients. Being spread in a wide area of oligotrophic regions to eutrophic regions shows that these species' environmental adaptation is quite interesting. Nutrient enrichment experiments have been performed for determination of growth limiting nutrient for species in community and nutrient limited growth of them. MONOD kinetics equation was used for this purpose ([1],[2],[3],[4]).

Material and Methods

Izmir Bay is one of the largest and polluted bay of the Turkish Aegean coast. The Izmir Bay is divided into inner, middle and outer Bay due to topographical and hydrographical characteristics. The main pollutants affecting the bay water quality are organic matter, suspended matter, hydrocarbons, metals and pathogenic organisms. The pathways through which these pollutants reach the bay are domestic and industrial wastes, rainfall, bay activities and ship traffic, rivers and streams, erosion, agriculturel and other sources [5]. For this study, experiment bottles were conducted in a constant temperature room at optimal temperature of the species and irradiated at 1300 ftCd (foot-candle) by daylight fluorescent lambs. Cultures were maintained on a 12:12 light:dark cycle. For stock culture and batch culture experiments, f/2 and h/2 mediums were used described by [6]. The experiments were carried out in 1 liter Pyrex bottles initially containing 1 liter of seawater. For the experiment, the concentrations of nutrients in f/2 medium were changed and thus, for every nutrient, a different concentration was obtained. For the experiment groups, nutrients, trace elements and vitamins were added seawater according to f/2 medium [6]. Our experiment was performed under non-limiting nutrient, light and temperature conditions except the nutrient exposured. Ammonium, phosphate, silicate and nitrate were analysed by spectrophotometric methods ([7],[8]). All of the spectrophotometric analyses were carried out by using Bosch-Lomb Spectronic 21 UVD model spektrophotometer and also chlorophyll *α* analysis were performed using Turner 10-AU Model Fluorometer.

Results and Discussion

According to analytical results, background seawater concentrations are given below: Nitrate: 3.2 μM, Ammonium: 15.79 μM; RP : 2.6 μM and Silicate: 29.20 μM. When we examined the growth curves of *Skeletonema costatum* at the different concentrations of silicate, ammonium and phosphate, we found no limitation for these nutrients hence these nutrient concentrations are not reached to limiting values in natural marine environment. Estimated growth rate means are μ_{avg}: 2.06 day^{-1} for silicate, 1.97 day^{-1} for ammonium and 1.70 day^{-1} for RP. At the different concentrations of nitrate enrichment experiments we observed that the population of S*keletonema costatum* is not able to grow in low nitrate concentrations. In the previous study it was reported *S.costatum* is growing better in batch culture with high N:Si ratio [9]. In winter period (in February) *Skeletonema costatum* growth was limited by nitrate. The highest cell number was reached to 38 millions cell/L. at the concentration of 886.2 μM nitrate. Maximum spesific growth rate of *S. costatum* was calculated as 2.34 day^{-1} and half saturation constant (Ks) as 6.9 μM using Monod equation. There is no limitation observed at enrichment experimets of T*halassiosira sp*. for the different concentrations of silicate, ammonium and nitrate. Estimated average growth rates are μ_{avg}:1.49 day^{-1} for silicate, μ_{avg}:1.25 day^{-1} for ammonium and μ_{avg}:0.97 day^{-1} for nitrate in natural environment. Enrichment experimets of RP at 10 different concentrations, the highest cell concentration was observed at 38.9 μM and the growth was stopped at high concentrations. At low concentrations the growth limitation could be clearly seen. At the natural background concentration we deduce that the growth rate of *Thalassiosira sp*. was reduced 50%. Using Monod equation, estimated maximum growth rate for *Thalassiosira sp.* was μ_{max}:1.73 $day^{-1}$and Ks was 2.018 μM for RP. In conclusion, according to our experimental results, it was determined that species which do not need high silicate concentration were dominant in winter period. *Thalassiosira sp.* species' high phosphate uptake ability was limited by RP. *Skeletonema costatum*'s growth rate was limited by nitrate. Light density is low in winter at Izmir Bay. In this condition it is known that certain species uptake nitrate at the precence of ammonium and can produce lower energetic fotosenthetic productions [10]. We pointed out that this species has an adaptation ability from oligotrophic conditions to eutrophic conditions.

References

1 - Eppley, R.W., W.H. Thomas., 1969. Comparison of half-saturation constants for growth and nitrate uptake of marine phytoplankton. *J. Phycol*. 5:375-79.

2 - Droop, M. R., 1974.The nutrient status of algal cells in continuous culture. *J. Mar. Biol. Assoc. U.K. 54: 825–855.*

3 - Caperon, J., Meyer, J., 1972. Nitrogen-limited growth of marine phytoplankton. i. changes in population characteristics with steady-state growth rate. *Deep Sea Research 19: pp.601-618.*

4 - Thomas, W.H., 1969. Phytoplankton nutrient enrichment experiments off baja california and in the eastern equatorial pacific ocean. *Journal Fisheries Research Board of Canada, 26(5): pp. 1133-1145.*

5 - Sunlu, U., 2004. The state of the marine pollution in the bay of Izmir. Workshop on artificial reef applications in fisheries and water quality enhancement. 24/09/2004. E.U. Faculty of Fisheries. Urla-Turkey.

6 - Guillard, R.R.L., 1975. Culture of phytoplankton for feeding marine invertebrates. in: Smith, W.L. and M. H. Chanley (Eds.), *Culture of Marine Invertebrate Animals.* Plenum Press, New York, NY.

7 - Strickland, J. D. H., T. R. Parsons., 1972. A pratical handbook of seawater analysis. *Fisheries Research Board of Canada. Bull.* 167. Ottowa, 310 p.

8 - Wood, R., 1975. Hydrobotanical meth. Univ. Park Press., Baltimore., *173p.*

9 - Roberts, Ec., Davidson, K., Gilpin, C., 2003: Response of temperate microplankton communities to N:Si ratio perturbation. *Journal of Plankton Research*. Vol. 25, Number. 12, 1485-1495.

10 - Levasseur, M., P.A. Thompson, P.J. Harrison., 1993. Physiological acclimation of marine phytoplankton to different nitrogen sources. *J. Phycol. 29, 587-595*.