P-I13

EFFECT OF SOME NUTRIENTS AND THEIR COMBINATION ON THE GROWTH OF NITZCHIA PALEA (KUTZ) W.SM.

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INTRODUCTION

Most studies of nutrients effects on algal growth relate to experiments where single element were applied. However in aquatic ecosystem, several nutrients are present together in different concentration and chemical forms. The aim of this work is to obtain approximate mathematical picture of the potential impact of multielement concentration (N, P, Fe and Si) on the growth of Nitzchia palea .

MATERIAL AND METHODS

The alga was cultured in modified Chu 10 solution. The complementary effect of N, P, Fe and Si was evaluated simultaneously by applying 2^4 factorial experiment (Cochran and Cox 1957) , where each factor occurs at only two levels -1 and +1. The scale of neutral variable change was chosen to be logarithmic, so the real element concentration in mg/L equivalent to the coding level -1, 0, +1 for the four elements was as follows: N (0.25, 1.0, 4.0), P (0.1, 0.3, 0.9) Fe (0.1, 0.253, 0.64) and Si (9,27,81). Experiments were performed in triplicates. Cultures were grown in incubators at a light intensity of 5K Lux and temperature of 25 ± 1°c. Experiment duration was 10 days.

RESULTS AND DISCUSSION

Statistical analysis for experimental data was carried out according to Cochran and Cox (1957) The regression model describing the dependence of culture growth (Y) (in 10^5 cell ml) on the different levels of N,P,Fe and Si at the different days of experiment are given in equation 1-5.

(1) $Y_2 = 415 + 78X_{Fe} + 62\,X_{Si} + 42\,X_{NPSi} + 38\,X_{NPFeSi}$

(2) $Y_4 = 664 + 241X_N + 267X_{Si} + 86X_{PFe} + 129X_{NSi} - 88X_{PSi} - 209X_{FeSI} + 130X_{NPFe} - 125X_{NPSi}$

(3) $Y6 = 1397 + 574X_N + 158X_p + 162X_{Fe} + 536X_{Si} + 105X_{NP} + 79X_{NFe} + 118X_{PFe} - 162X_{FSi} + 416X_{NSi} + 186X_{NFe}$

(4) $Y_8 = 1367 + 499X_N + 177X_p + 609X_{Si} + 363X_{NSi} - 231X_{FSi}$

(5) $Y_{10} = 1392 + 488X_N + 233X_p + 183X_{Fe} + 485X_{Si} + 137X_{NP} + 165X_{NFe} + 321X_{NSi} - 129X_{FeSI} + 138X_{NPFe}$

From these models it is clear that within the concentration level range of the 4 elements studied, the change from a lower element concentration to a higher one leads to significant increase in algal growth. This is indicated in model equation by the positive linear regression coefficients of N,P,Fe and Si). In some models these coefficients are missed as their values were non-significant, but the effect of these elements can be easily noticed through their intereffect with the other elements. In general, beside the positive linear effects, there are some intereffects which strongly affect culture growth. All over the time of experiments, cultures were affected by 2 unlike intereffects. The positive intereffect of nitrogen with silicon and the negative intereffect of Fe with Si. This means that although the effect of nitrogen on culture growth positively depends on the concentration level of silicon the effect of the latter is weakened by increasing Fe level in culture media. This may be due to the coating of insoluble silicates of iron formed after the absorbtion of the irons or hydroxides of this element by silicon (Riley and Chester 1971).

During the first six days of experiments, culture growth was largely affected by the positive intereffect of P with Fe. This intereffect was previously noticed by Fedorov et al. (1970) and Abdalla (1986), but till now it is not well discussed. Beginning with the sixth day of growth till the tenth day, the positive intereffect of N with P was more pronounced. The synergistic effect of simultaneous N and P addition on culture growth have been discussed by several authors. Gatham and Rhee (1981) considered that algal growth is a function of external and internal content of N and P. Increasing nitrate concentration in culture media, stimulates both N and P uptake by algal cells establishing different amounts of cell N and P needed for cell division.

Data of this experiment shows that the dependence of culture growth on the concentration level of the four studied elements is a complicated process. Culture growth is mainly affected by N, Si and their intereffect. Nitrogen, in its turn, stimulates algal growth through its intereffect with Phosphorous. At the same time, silicon effect is inhibited by its intereffect with iron. On the other hand the latter stimulates algal growth specially at its early stages through its intereffect with phosphorous.

REFERENCES

1. Abdalla, R.R. 1986 - The combined effect of nitrogen, phosphorous and iron on the growth of Selenastrum gracile Reinsch. Aquatic Botany, 23.
2. Cochran, W.G. and Cox G.M. 1957. Experimental designs . 2nd edition. Wiley publication in Applied statistics, Wiley New York.
3. Fedorov, V:D., Belaya, T.I. and Maksimov, V.N. 1970. Utilization of biogenic elements by a phytoplankton community in relation to their concentrations in aquatic environment and illumination conditions. Izv. Akad. Nauk. USSR. Sev. Biol., 3: 398-414 (in Russian)
4. Gatham I.J. and Rhee, G-Y, 1981. Comparative Kinetic studies on nitrate limited growth and nitrate uptake in phytoplankton in continuous culture . J. phy-col. , 17:309-314
5. Riley, J.P. and Chester R., 1971. Introduction to marine chemistry. Academic Press, London and New York, 465 p.

P-I14

SEASONAL DATA ON PLANKTONIC PRIMARY PRODUCTIVITY IN SOUTH-EASTERN MEDITERRANEAN WATERS

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Abstract

Planktonic primary productivity data of the south-eastern coastal waters of the Mediterranean, based on chlorophyll a determinations during February-March (0.12 to 9.6 mg C m^{-3} d^{-1}) and July-August (0.12 to 7.2 mg C m^{-3} d^{-1}), are presented.

Résumé

On présente des données concernant la productivité primaire planctonique des eaux côtières sud-est méditerranéennes, basées sur des déterminations de la chlorophylle a, pendant les saisons fevrier-mars (0,12 - 9,6 mg C m^{-3} $jour^{-1}$) et juillet-août (0,12 - 7,2 mg C m^{-3} $jour^{-1}$).

Planktonic primary productivity is an expression of phytoplankton biomass per unit time. For the Mediterranean Sea it is also considered to result from closely interrelated ecological factors. Such data are very scarce for the Eastern basin and are non-existant for its south-eastern coastal waters.

MATERIAL AND METHOD

Phytoplankton samples for estimating the primary productivity were collected between Ras Karkura (31°28'N, 20°00'E) and Ras Azzaz (31°58'N, 24°59'E) Libya during February-March and July-August 1975. Twenty-one transects, with sampling at 0, 10, 25, 50, 75, 100, 150 and 200 m depths (sometimes also 300 and 400 m), were performed 12 nautical miles offshore. From a total of 84 stations the chlorophyll a content was determined in 864 samples.

Primary productivity was estimated on the basis of the chlorophyll a content; the concentration of chlorophyll a was spectrophotometrically measured with a Beckman M25 equipment (RICHARDS and THOMPSON, 1952; STRICKLAND and PARSONS, 1965) and calculated using the trichromatic equations (UNESCO, 1966).

Computation of primary productivity was carried out by means of the conversion factor F=60 used for natural populations from warm oligotrophic waters (STRICKLAND, 1960).

RESULTS AND DISCUSSION

The determination of chlorophyll a concentrations and primary productivity distribution in the mentioned sector was possible only in the eastern half, between Appolonia and Ras Azzaz, during both seasons. In the western half, the extinctions of chlorophyll a were below the detection limit of the method used. The chlorophyll a concentration ranged between 0.02 to 0.16 mg m^{-3} in the winter season and between 0.02 to 0.12 in the summer season. Accordingly, it appears that the primary productivity values, ranging between 0.12 to 9.6 mg C $m^{-3}d^{-1}$ and 0.12 to 7.2 respectively, were similar in both seasons.

The low and similar values indicate the presence of uniform water masses with a very low primary productivity level. These oligotrophic waters are similar to those reported for the region between the Channel of Sardinia and the Algerian-Tunisian sector (COSTE and MINAS, 1968; COSTE et al., 1969; GEORGIEVA, 1976). The results obtained are also very close to more recent data, based on ^{14}C estimates, from different sectors of the Mediterranean Sea including the Strait of Sicily (BOLOGA and PARKHOMENKO, in press). But, contrary to the known eastward decrease of primary productivity along the north African shore, the surface chlorophyll a concentration and the primary productivity gradually decreased from Appolonia westward.

Vertically, higher chlorophyll a concentrations usually occurred between 50 and 150 m, as a consequence of an increase in nutrient supply due to the influence of the Atlantic Current. No chlorophyll a were evident at 300 and 400 m depths.

REFERENCES:

BOLOGA A.S., PARKHOMENKO A.V., in press - Rapp. Comm. int. Mer Médit.
COSTE B., MINAS H.-J., 1968 - Rec. Trav. St. mar. Endoume, 44, 60, 49-61.
COSTE B., MINAS H.-J., NIVAL P., 1969 - Téthys, 1, 3, 573-579.
GEORGIEVA L.V., 1976 - Biol. moria, 37, 9-12.
RICHARDS F.A., THOMPSON T.G., 1952 - J. Mar. Res., 11, 156-172.
STRICKLAND J.D.H., 1960 - Fish. Res. Bd. Canada, 122, 1-172.
STRICKLAND J.D.H., PARSONS T.R., 1965 - in A Manual of Sea Water Analysis, Fish. Res. Bd. Canada, 125, 107-112.
UNESCO, 1966 - in Determination of photosynthetic pigments in sea water (Monogr. on oceanogr. meth. 1), Montreux, 9-18.

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