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A STUDY ON THE PRIMARY PRODUCTIVITY IN THE SHATT AL-ARAB ESTUARY AT BASRAH, IRAQ.

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ABSTRACT

The Primary productivity was measured in the Shatt Al-Arab estuary and five of its main canals around the center of Basrah city. The primary productivity of the estuary and two of its eastern canals was rather low and ranged from 18.5 to 52.9 mg C^{-3} h^{-1} . The primary productivity in three of its western canals (major sewage-discharging canals) was very high and ranged from 31.5 to 3180.9 mg C^{-3} h^{-1} . Chlorophyll-a analysis at the same stations showed a similar trend. These variations were documented with NH_3 -N, PO_4 -P and SiO_2 -Si results.

INTRODUCTION

The Shatt Al-Arab estuary originates from the confluence of the Tigris and the Euphrates rivers at Garmat Ali upstream of Basrah city. It extends for 120 km in a south eastern direction and drains into the Arab Gulf. It has several hundred canals on either sides. These canals carry into the estuary the untreated sewage of Basrah city, the industrial effluents and the agricultural waste. The whole ecosystem is the only source of water supply in the arid surrounding area of southern Iraq. The ecosystem forms a suitable habitat for the growth and reproduction of a large number of fishes

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(1,2). Little is known about the primary productivity in the Shatt Al-Arab estuary and the published reports are scarce and fragmentary (3). However, several studies were made on the hydrology, ecology, algology nad pollution of this ecosystem (4,5,6,7,8,9,10).

The present study is an attempt to survay the primary productivity in the Shatt Al-Arab and its main back water canals around the centre of Basrah city. It is aimed to evaluate the effect of sewage, industrial and agricultural inputs on the primary productivity in the estuary and the canals.

STUDY AREA

The studied area lie in a hot arid climate zone. The environmental background was given by several authers (9,11). samples were collected from thirteen station selected in the Shatt Al-Arab estuary and the major five canals joining it (Fig.1). Three stations (1,2,3) were located in the estuary up and downstream Basrah city center. Four stations (4,5,6,7) were located in the Chibssi and Salehiya canals, on the east side of the Shatt Al-Arab (eastern canals). These canals run through a sparsely populated agricultural land.They were selected to study the effect of agricultural run-off and waste on the trophic level of the water in these canals and in Shatt Al-Arab. Six stations (8,9,10,11,12,13) were located in the Al-Khandak, Ashar and Khora canals, on the west side of Shatt Al-Arab estuary (western canals). These canals run through the center of Basrah city and they were the most polluted canals of the west side of Shatt Al-Arab. They receives the untreated sewage from the densely populated area of Basrah city and also receives the untreated wastes from many factories and industrial centers, such as a dairy factory and the slaughter-house of Basrah. These six stations were selected to show the effect of the urban and industrial wastes on the trophic level of the water in these canals and in Shatt Al-Arab.

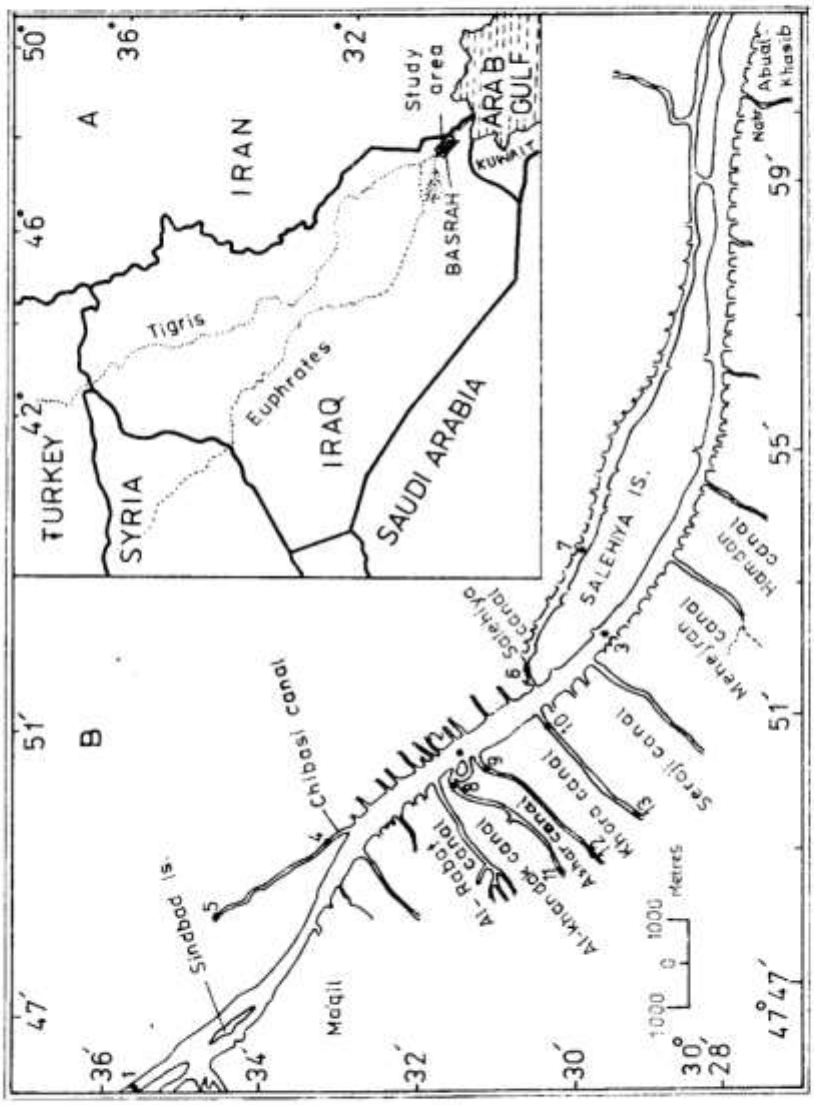

Fig.1. Map of the study area showing the sampling stations.

MATERIALS AND METHODS

The study was performed on two succesive days (27.11.1985 and 28. 11. 1985). Air and water temperature were measured using thermometer accurate to 0.1°C. Transparency was estimated by a Seechi disc of 30 cm diameter. The pH was measured in situ by a digital portable pH meter (Schatt Gerate Model CG 817).

Dissolved oxygen content was determined by the azide modification of the standard method as described by Mackereth et al. (12). water samples for chemical analysis and primary productivity measurements were collected from the topmost 20 cm. They were collectec in clean polyethylen bottles (ca. 4.5 1). Duplicate samples were used for all measurements except dissolved oxygen content where three samples were used. Total available carbon dioxide was determined according to the method of (13) as described by (14). Salinity was measured using a digital laboratory salinometer (Tsuruni Seiki model E 202). Ammonia-nitrogen was estimated according to Solarzano (15) as described by Parsone et al. (16), nitrite-nitrogen following the method of Bendischneider and Robinson (17), nitrate-nitrogen was determined after reduction to nitrite using a cademium columen as described by Wood et al. (18). Phosphate-phosphorus was determined according to Murphy and Riley (19) as described by Parsone et al. (16). Silicate-silicon was measured as described by Parsone et al. (16).
Chlorophyll-a was extracted using 90% acetone and calculations were made according to Lorenzens equation (20).

Primary productivity was determined by the light and dark bottle method. 4 μ Ci $NaH^{14}CO_3$ per 100 ml water sample incubated for two hours. Simulated in situ technique were made using artificial light incubator (supplied by Carbon 14 Centralen, The Danish Academy of Technical Sciences, Denmark) at temperature (20°C) and light (2400 lux). After the incubation period, the samples were filtered and dried over silica gel in a desiccator and then exposed to the vapours of concentrated HCl. The radioactivity was measured by the Liquid Scintillation Counter (Philips LSC PW 4700). Calculations were carried out as described by Hadi (14).

RESULTS AND DISCUSSION

The data of some physico-chemical parameters are shown in Table 1. The values of temperature and pH showed only a slight variations among the studied stations. Transparency (Secchi disc reading) and dissolved oxygen content were higher in the Shatt Al-Arab and the eastern canals than in the western canals. The values of total CO_2 showed a reverse pattern to the oxygen content. Low transparency, low dissolved oxygen and high CO_2 were mainly due to high suspended material of the disposed untreated sewage and the breakdown of organic matter by bacteria and other organisms (3,7,8,21,22).

The concentration of inorganic nitrogen fractions are shown in Fig. 2. Very high values of NH_3-N were recorded in the western canals then in the eastern canals and Shatt Al-Arab. NO_2-N were generally low in almost all of the studied stations. NO_3-N values were high in the eastern canals and Shatt Al-Arab. They showed a reverse pattern in their values to that of NH_3 -N The very high values of NH_3 -N in the western canals could be due to the disposal of great amount of untreated sewage. It is evident from many studies that the contribution of untreated sewage (organic matter) for NH_3-N could be considerable (22-27). Higher values of NO_3-N in the eastern canals might be principally attributed to the agricltural runoff (28, 29). Increase of NO_3-N concentration in the Shatt Al-Arab could be due to the agricultural runoff and the sewage effluent (7,8,28,29). Another source of NO_3-N in the Shatt Al-Arab may be from the continuous supply of oxidized sewage (NO_2-N) which came from the western canals during the low tide. This may be the cause of low NO_2-N values in the area.

Fig.3 summarises the values of salinity, PO_4-P and SiO_2-Si concentrations. The salinity and PO_4-P were higher in the western canals than in the esturay and eastern canals. SiO_2-Si values were also high in the western canals except in stations 9 and 10. Sewage disposal (including disposal of detergent) was probably the factor behin d the high PO_4-P content of western canals (26,27). Low concentrations of PO_4-P in the Shatt Al-Arab and eastern canals were likely due to the adsorption, sedimentation and dilution affect (30).

The values of primary productivity ranged from 31.5 to 3180, from 24.9 to 25.6 and from 18.5 to 52.9 mg C m^{-3} h^{-1} , and those of chlorophyll-a from 0.97 to 8.21, from 0.35 to 0.43 and from 0.43 to 0.47 mg m^{-3} at stations of the western canals, Shatt Al-Arab and eastern canals respectively (Fig.4).

The remarkable increase of primary productivity and chlorophyll-a content in the polluted western canals were mainly due to the eutrophication processes as a result of the high concentrations of inorganic nutrient in the domastic sewage which disposed to these canals. Increase of inorganic nutrients which accompanied by high biomass and high primary productivity were also recorded by previous studies on the polluted canals at Basrah city (3,8,16,31). The relatively low values of primary productivity and chlorophyll-a in the Shatt Al-Arab and the eastern canals during the present study reflected the condition of less pollution in these stations. This is in agreement to the finding of other studies (3,5,8). The results of the present study support the views of Lewis and Weibezehn (32), in that the production of suspended organisms in streams is low.

An attempt was made to find a possible correlation between the primary productivity and some of the physico-chemical parameters studied, which are likely to have an effect.

The results showed that at 5% level of probability there was a positive correlation with chlorophyll-a content ($r = 0.78$), NH_4-N ($r = 0.77$), PO_4-P ($r=0.68$) and SiO_2-Si ($r = 0.45$). Negative correlation was found with transparency ($r = - 0.44$). Schiewer et al. (3) had also showed that the primary productivity in the Shatt Al-Arab is light limilted.

From the results of the present study, it may be concluded that sewage and industrial wastes of Basrah cause an increase in nutrient content and probably the primary productivity of the western canals. In Shatt Al-Arab on the other hand the effect was less (Fig. 4). The agricultural runoff, at the present time, seems to have little effect on the primary productivity in the eastern canals.

Table 1. some physico-chemical parameters of the studied stations.

	Stations												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Temperature (C)													
Air	17.4	18.4	19.7	17.9	18.2	18.4	19.7	23.2	22.2	21.2	17.4	19.8	21.0
Water	18.4	18.7	18.8	18.3	19.2	18.6	18.8	20.0	19.4	18.5	18.2	19.0	17.0
pH	7.75	7.65	7.57	7.55	7.59	7.55	7.55	7.71	7.43	7.44	7.82	7.65	7.62
Secchi disc (cm)	85	80	80	50	75	50	70	15	65	15	22.5	15	30
Dissolved oxygen (mg l^{-1})	6.57	6.48	6.76	6.40	6.69	6.46	5.92	4.25	3.79	4.27	1.48	0.9	1.43
Dissolved oxygen (% saturation)	70.2	69.3	72.5	68.4	72.9	69.9	63.3	46.5	41.3	45.6	15.5	9.1	15.7
Total CO_2 (mg l^{-1})	184.5	174.7	165.1	175.0	207.3	174.0	166.5	426.5	361.9	200.9	302.6	484.4	406.7
Date of collection	27.11. 1985	27.11	27.11	27.11	27.11	27.11	27.11	28.11. 1985	28.11	28.11	26.11	26.11	26.11

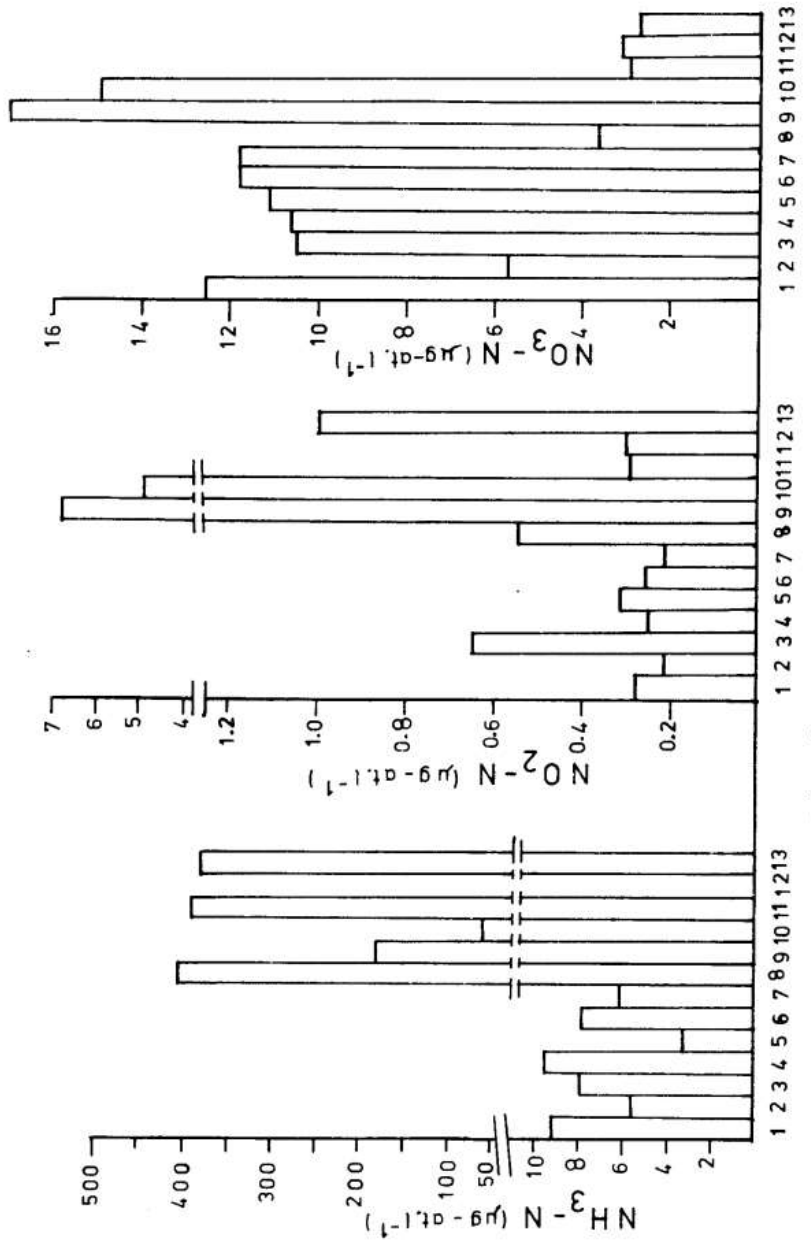

Fig.2. NH_3-N, NO_2-N and NO_3-N concentrations in the studied stations.

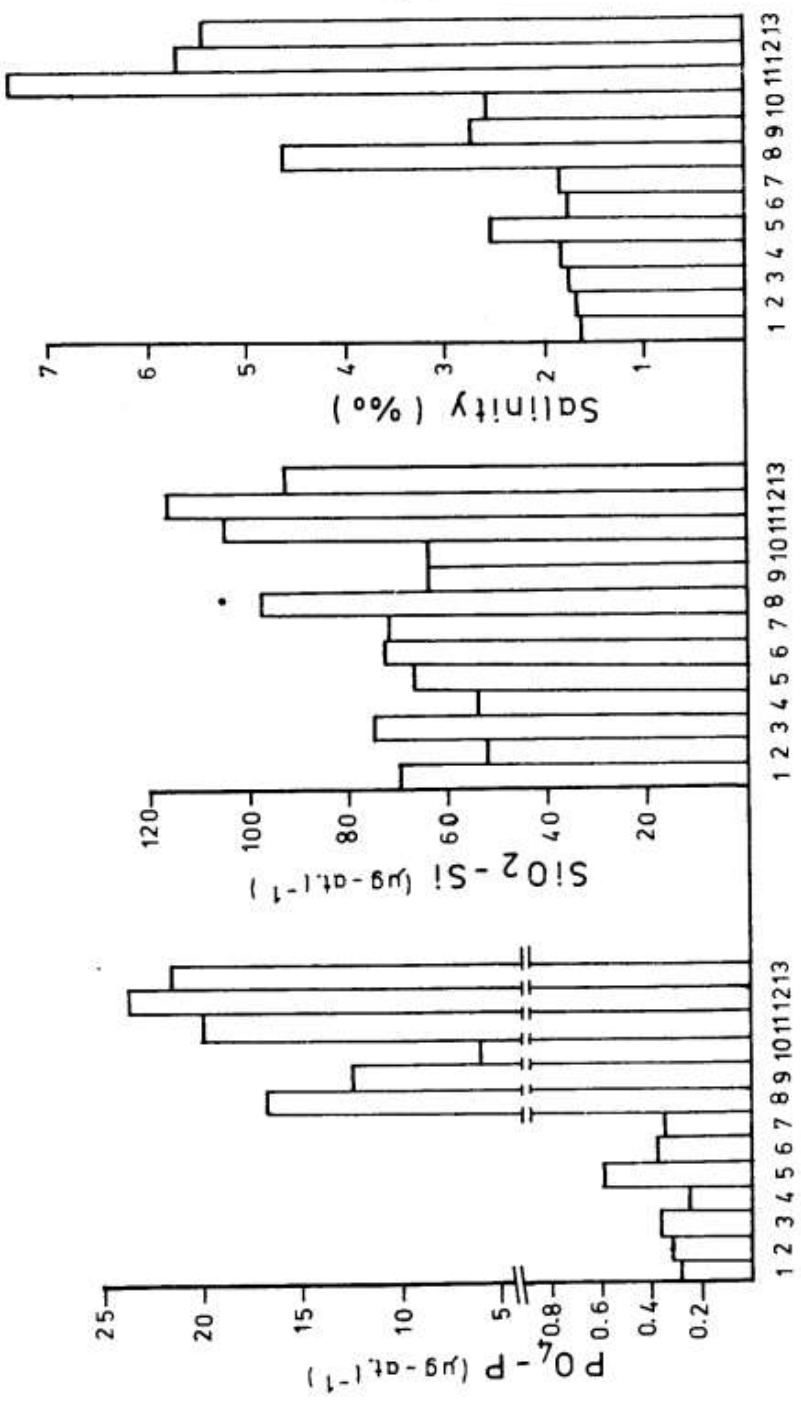

Fig.3. Salinity, PO_4-P and SiO_2-Si concentrations in the studied stations.

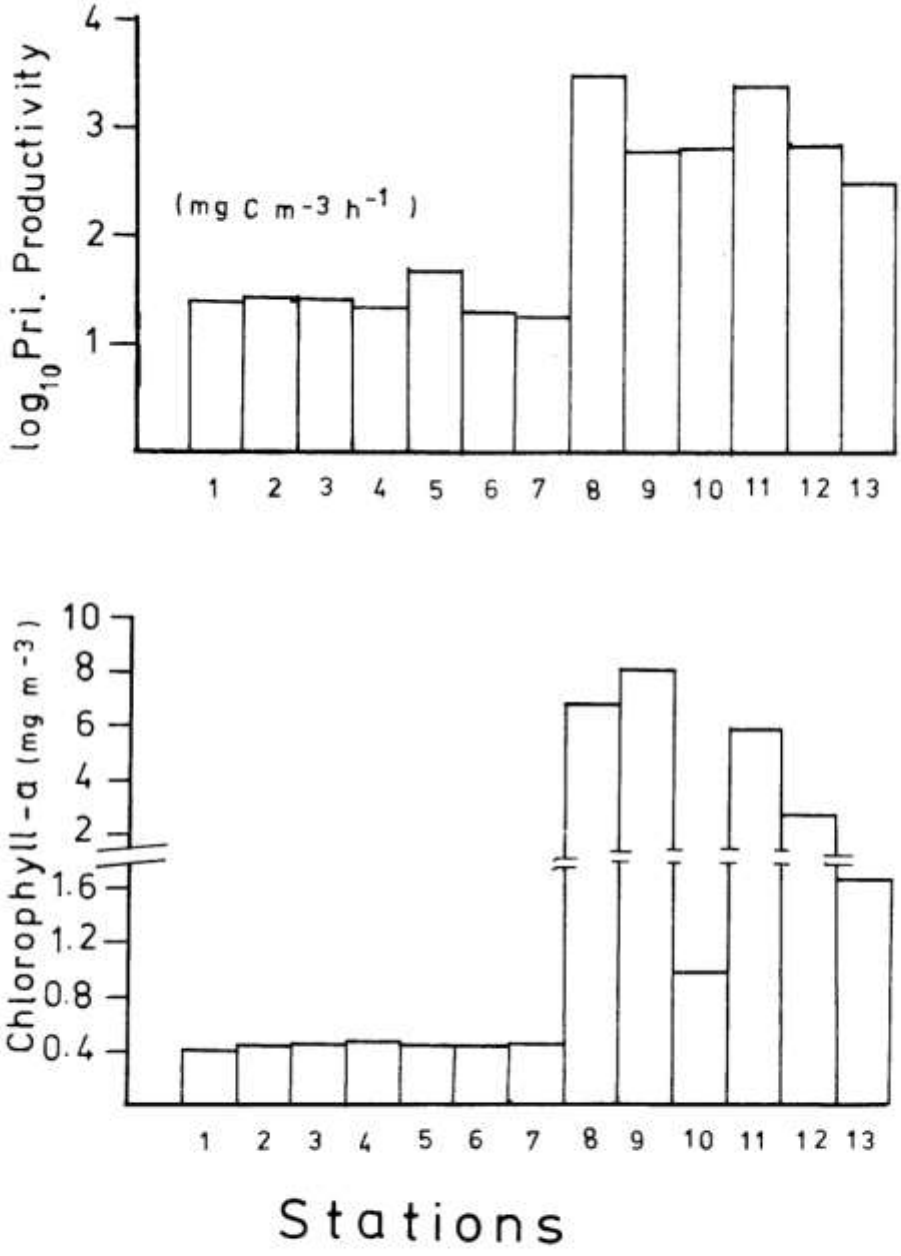

Fig.4. Chlorophyll-a content and primary productivity in the studied stations.

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دراسة عن الانتاجية الاولية في شط العرب عند البصرة ـ العراق

رافع عبد المجيد هادي ، عبد الله حمد الموسوي و عبد الجليل محمد الزبيدي .

قسم علوم الحياة ـ كلية العلوم ـ جامعة البصرة

المستخلص

تم قياس الانتاجية الاولية في شط العرب وخمس من قنواته الرئيسية عند مدينة البصرة . كانت الانتاجية الاولية منخفضة (من ٥ر١٨ الى ٩ر٥٢ ملغم كاربون بالمتر المكعب بالساعة) في محطات شط العرب والقناتين الواقعتين على الضفة اليمنى للشط . وكانت الانتاجية الاولية مرتفعة جدا في الثلاث قنوات التي تقع على الضفة اليسرى من شط العرب وتراوحت من ٥ر٣١ ـ ٣١٨٠ ملغم كاربون بالمتر المكعب بالساعة . لوحظت تغيرات مماثلة لكمية الكلوروفيل ـ أ في عينات المياه بالمحطات المدروسة . نتائج تراكيز الاملاح المغذية بالمحطات المختلفة (نيتروجين الامونيا وفوسفور الفوسفات وسليكون السليكات) تعزز التغيرات الحاصلة في الانتاجية الاولية .

العنوان الحالي : قسم علوم الحياة ـ كلية التربية للبنات ـ جامعة بغداد