Dhaka Univ. J. Biol. Sci. 9(1) : 87-92, 2000 (January)

EFFECTS OF INORGANIC FERTILIZERS ON SOME PHYSICO-CHEMICAL PARAMETERS OF WATER AND PRODUCTION OF ZOOPLANKTON

AKHTERUNNESSA CHOWDHURY[1], GULSHAN ARA LATIFA,
S. M. IMAMUL HUQ[2] AND ULFAT JAHAN

Department of Zoology, University of Dhaka,
Dhaka-1000, Bangladesh

Key words : Inorganic fertilizer, Physico-chemical parameters, Zooplankton density

Abstract

Effects of inorganic fertilizer on the zooplankton density have been studied in three seasons. Muriate of potash (K) was found to be most effective among the inorganic fertilizers used viz., urea (N), triple super phosphate (P), muriate of potash (K) and a mixture of N : P : K. It contributed 34.6% of total zooplankton production during the investigation period. Spring was found to be the best productive season with the application of muriate of potash. Production of zooplankton showed significant positive relationship with chlorophyll during Autumn (r = 0.747) and Winter (r = 0.591). Whereas inverse relationship was observed between zoopolankton abundance and dissolved oxygen in Autumn (r = 0.647) and Winter (r = 0.463). In Spring the population of zooplankton showed significant negative relationship with carbon dioxide (r = 0.538).

Introduction

Scientific management of fisheries without a knowledge of primary production is difficult. Therefore, study on the qualitative and quantitative aspects of plankton and its dynamics with the changing water quality is of utmost importance and essential for scientific management of fisheries.(1) Fish production is effected by the productivity of the plankton and benthos, these in turn depend on the nutrient cocentration of the water derived from natural, artificial and supplemental sources. Artificial source includes fertilization of the pond, either by inorganic or organic fertilizer. Monitoring on the increased production of plankton in a fish pond is the best way to increase the natural food sources for fishes.(2) It is known that zooplankton constitutes the important food source for both

[1]To whom correspondence and reprint requests should be made. [2]Department of Soil Science, University of Dhaka, Dhaka-1000, Bangladesh.

carnivorous and omnivorous fishes. The increase in the primary productivity following fertilization usually results in greater zooplankton abundance.[3] In the fertilization of ponds inorganic fertilizer has been found to be more economical than organic fertilizer.[4] Use of organic fertilizer for fish production involves periodic drainage, drying and scaraping of the bottom soil of the pond and incur more costs.[5]

An attempt has therefore been made in the present investigation to find out the optimum inorganic fertilizer dose to increase the production of zooplankton by manipulating the change in the physico-chemical characteristics of the water.

Materials and Methods

The experiment was carried out in the Zoological garden of Dhaka University in 13 earthen containers (83 cm × 47 cm) from November 1992 to January 1994. Four fertilizer treatments each in triplicates were applied. There was a single control treatment, which contained no fertilizer but tap water. The inorganic fertilizers used were urea (46% N), triple super phosphate P (45% P_2O_2), muriate of potash K (80% K_2O) and a mixture of N : P: K in 8 : 4 : 2 and 1 : 1 : 1, respectively. There were three applications of each of the fertilizer doses in Autumn, Winter and Spring. Applications of fertilizer were made at two days interval and inocula of plankton collected from a pond was released after the third application. Sampling for the analysis of water and counting of plankton was done after seven days of inoculation. Water sample (5 ml) from each container was collected monthly and preserved in 5% formaline. Zooplankton in the samples were identified following standard literatures,[6,7] and numerical estimation was done by a Sedgewick Rafter counting cell under microscope.

Analysis of the various physico-chemical characteristics of water was done following standard methods described here in.[8]

Results and Discussion

The mean with the standard deviation of different physico-chemical parameters in four inorganic fertilizer treatments and the control are presented in Table 1. The numerical count and percentage composition of zooplankton in four fertilizer media and the control are plotted in Fig. 1. pH and electrical conductivity (Ec) in all the four treatments were lower than that of control and were within productive limit.[9] Very little variation in the potassium contents of the water samples was observed irrespective of treatments. Cholorophyll concentration varied from 0.011 to 0.015 mg/l in the four treatments and it was 0.010 mg/l in the control. Dissolved oxygen and free carbondioxide of the four treatments showed

Table 1. Physico-chemical conditions of the water of different treatments with fertilizer and control.

Fertilizer	Physico-chemical variables							
	pH	EC µs	K ppm	Na ppm	Chl. mg	CO_2 ppm	DO_2 ppm	Temp. °C
Urea	7.11 ± 2.69	586.59 ± 377.51	42.88 ± 23.66	72.88 ± 25.09	0.011 ± 0.004	1.95 ± 1.19	8.50 ± 0.80	20.33 ± 2.86
T.S.P.	8.32 ± 0.59	577.62 ± 403.80	42.05 ± 9.74	59.44 ± 5.63	0.11 ± 0.009	1.77 ± 1.03	8.46 ± 0.62	20.33 ± 2.86
M.P.	7.44 ± 2.69	521.61 ± 397.96	58.97 ± 21.74	77.44 ± 4.23	0.015 ± 0.015	1.77 ± 1.03	8.16 ± 0.47	20.33 ± 2.86
N.P.K.	8.01 ± 0.63	652.71 ± 440.22	50.66 ± 13.95	65.66 ± 13.61	0.007 ± 0.004	2.00 ± 1.21	8.43 ± 0.84	20.33 ± 2.86
Control	8.66 ± 0.00	810.00 ± 0.00	59.00 ± 0.00	53.00 ± 0.00	0.010 ± 0.00	2.25 ± 0.00	9.00 ± 0.00	17.00 ± 0.00

lower values than the control although there was not much variation among the treatments. Temperature were almost same in four treatments and these were at a higher level than control (Table 1).

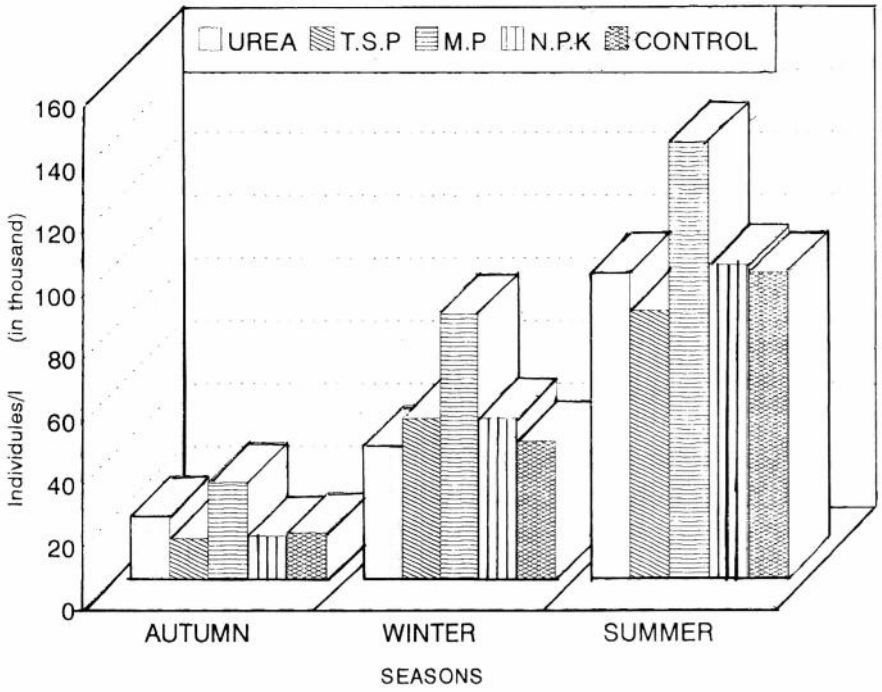

Fig. 1. Total zooplankton population in different treatments and different seasons of the year.

The multiple regression analysis of zooplankton abundance (indv./l) as function of physico-chemical factors of treated water for Autumn period showed significantly positive correlation with cholorophyll ($r=0.747, <0.001$) and dissolved oxygen ($r=0.647$, $p<0.05$). Cholorophyll concentration correlated significantly in negative way ($r= -415$, $p<0.05$) with dissolved oxygen. In Winter season, zooplankton abundance (indv./1) showed a positive and significant relationship ($r=0.591$, $p<0.05$) with dissolved oxygen.

pH in four treatments was within the productive limit.[9] pH of the treatment done only with muriate of potash was found to be the most favourable for zooplankton abundance. In this treatment 4.86% of the total zooplankton production was observed. Similar observations were made by Valladolid *et al.*[10] pH also showed a direct significant relationship with potassium. High growth of

zooplankton with present range of pH value is also reported in Bangladesh[11,13] and in India.[14] During the present investigation high abundance of zooplankton was associated with low value of electrical conductivity. Higher values of sodium in all the four treatments could be due to its addition as impurities with the inorganic fertilizer. High cholorophyll concentration in control (Table 1) indicates higher garzing effect by zooplankton abundance in treatments. Lowest corbon dioxide in Winter during this investigation contradicts with the findings of others.[11,12,15] High zooplankton abundance with low amount of free carbon dioxide and *vis a vis* in different seasons might be due to the consumption of carbon dioxide by the assimilation process of phytoplankton. Carbondioxide showed inverse and significant relationship in Spring because of the high growth of phytoplankton which, in turn, increased the zooplankton production. Similar observations were also found in other studies carried out in Bangladesh.[11,16] The content of dissolved oxygen in any water body is associated with various biological processes.[17] In the present investigation the relationship between the dissolved oxygen concentration and water temperature followed the general pattern.[16,18] An increase in the population of zooplankton was observed in the treatment where only muriate of potash fertilizer was used (Fig. 1). On an average this increase was about 34.6% of the total zooplankton population in different seasons. Spring was found to be the most productive followed by Winter and Autumn.

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(Manuscript received on 24 October, 1997; revised on 19 June, 1999)