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EFFECT OF NITROGEN AND PHOSPHORUS ON THE ABUNDANCE OF INDIGENOUS CYANOBACTERIA IN SALINE RICE FIELD OF SOUTHERN PART OF BANGLADESH

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Application of nitrogen 0,60 and 120 kgh^{-1} showed an adverse nonsignificant impact on the growth of indigenous cyanobacteria in a saline rice field ecosystem after 30, 60 and 90 days of transplantation of rice seedlings. However, phosphorus (@ 0, 30,60 kg ha^{-1}) exerted a significantly positive and stimulative role on the propagation of indigenous cyanobacteria. Combination of phosphorus with nitrogen overcome the negative role of nitrogen significantly at the lower rate of nitrogen only showing its leveled off effect at the higher rate of nitrogen. Maximum growth of cyanobacteria was recorded at 60 days of transplantation of rice seedlings.

Keywords: Indigenous cyanobacteria; Nitrogen; Phosphorus Abdundance; Saline rice field.

Introduction

The existence of cyanobacteria in the flooded rice soils and their contribution to atmospheric nitrogen fixation have been well recognized[1-4]. Among the natural and indigenous agents of nitrogen fixation in the rice field ecosystem, the significance of cyanobacteria deserves much more attention recently due to raise in the cost of synthetic N-fertilizer. The process of biological nitrogen fixation comprises a complex biochemical pathway and the amount of N fixed depends on abundance of cyanobacteria in soil and their inherent potential capacity. The growth of the N_2-fixers and the extent of nitrogen fixation significantly depend on the physicochemical conditions of the rice field ecosystem.

The use of HYV rice causes the tremendous mining of some nutrients viz. NPK together with Zn resulting their depletion in the soil. To meet the crop requirements, the use of these fertilizers become unavoidable for intensive rice farming practices. This necessitates the tremendous input of fertilizer to yield maximum output where the significantly positive impact of P-fertilization on cyanobacterial growth in rice field ecosystem has already been demonstrated [1,2,5].

Number of reports are available in the literature on the performance of cyanobacteria in the non problematic rice fields[3,4] in contrast to meager information on their behaviour in problem saline soil. Thus, a field experiment was designed to evaluate the role of N and P on the growth of cyanobacteria in a saline belt of southern part of Bangladesh.

Material and Methods

In the southern part of Bangladesh, a field experiment was conducted in a moderately saline (Ec 5.1dm^{-1}) rice field at Teligati in the district of Khulna during *boro* season. N as urea (0, 60,120 kg N ha^{-1}) and P as TSP (0, 30, 60 kg P ha^{-1}) in a full factorial combination together with a basal dose of K as MP (60 kg K ha^{-1}) were applied using BR-28 as the test crop. The field was ploughed mechanically, watered and leveled. Finally, the land was divided into three blocks. Each block was again subdivided into nine sub plots. The unit plot (4m× 2m) was separated from each other by levy. Nine treatments, in triplicate, were used in the experiment.The design followed was a randomized block one. The fertilizers were broadcasted as per treatment combinations. N and P were applied into two equal splits during land preparation and maximum tillering stage of growth of rice plant.

Thirty days old healthy and uniform HYV of seedlings of rice (BR-28) were collected from farmer seed bed. Three seedlings were transplanted in each hill. The hill-to-hill distance was 6 inches. Weeds were controlled manually as and when required. Irrigation was given time-to-time to maintain the water level (half inches above the soil surface). Soil samples were collected from each plot at 30, 60 and 90 days of transplantation for quantitative estimation of cyanobacteria.

Results and Discussion

Effect of nitrogen and phosphorus on the growth of

Table 1. Effect of nitrogen and phosphorus on the abundance of indigenous cyanobacteria ($\times 10^4$ g^{-1} soil) in rice field.

Treatments	Days of transplantation		
	30	60	90
N_0P_0	30.27 f	39.87 cd	37.27 cd
N_0P_{30}	44.10 d	48.70 c	41.77 c
N_0P_{60}	61.37 b	67.73 b	59.10 b
$N_{60}P_0$	27.63 f	40.80 cd	28.43 e
$N_{60}P_{30}$	56.17 c	66.27 b	63.57 b
$N_{60}P_{60}$	70.83 a	82.03 a	74.47 a
$N_{120}P_0$	26.90 f	32.07 d	31.03 de
$N_{120}P_{30}$	35.37 e	45.73 c	38.90 cd
$N_{120}P_{60}$	36.43 e	44.27 c	41.67 c

Level of significance, P = 0.05.

In a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT.

cyanobacteria was found to be influenced appreciably at Teligati site located in Khulna district (Table 1). Addition of phosphorus caused a significant increase in the number of cyanobacteria with the increase in the level of the fertilizer at 30, 60, and 90 days of transplantation of rice seedling.

At 30 days of transplantation, the maximum number of cyanobacterial population (70.83×10^4 g^{-1} soil) was found in the treatment receiving 60 kg P and 60 kg N ha^{-1} together. The second highest number ($61.37\times10^4 g^{-1}$ soil) of cyanobacterial population was recorded in the plot supplied with 60 kg P ha^{-1} only. Contrary to this, the lowest number of cyanobacterial population (26.90×10^4 g^{-1} soil) was enumerated in the treatment where 120 kg N ha^{-1} was applied singly. Very close number of cyanobacterial population i.e. 35.37×10^4 g^{-1} soil and 36.43×10^4 g^{-1}soil was recorded in the treatments receiving 120 kg N with 30 kg P ha^{-1} and 120 kg N along with 60 kg P ha^{-1} respectively. However, the number of cyanobacterial population was found to increase significantly with the increasing amount of phosphorus applied. In contrast, cyanobacterial population was found to decrease with the increase in the level of nitrogen though not significantly.

At 60 days of transplantation, the maximum cyanobacterial population (82.03×10^4 g^{-1} soil) was observed in the plot treated with N and P at the rate of 60 kg ha^{-1} together. Application of 30 kg P ha^{-1} showed 48.70×10^4 g^{-1} soil cyanobacterial population and the number increased significantly to 67.73×10^4 g^{-1} soil when the amount of phosphorus increased from 30 to 60 kg ha^{-1}. Contrary to this, the number of cyanobacterial population reduced from 39.87×10^4 to 32.07×10^4 g^{-1} soil due to increase in application of nitrogen from 0 to 120 kg ha^{-1} though not significantly.

At 90 days of transplantation, the lowest number of cyanobacterial population (31.03×10^4 g^{-1} soil) was recorded in the plot treated with 120 kg N ha^{-1}. Application of 30 kg P ha^{-1} showed $41.77\times10^4 g^{-1}$ soil of cyanobacterial population and the number increased significantly to 59.10×10^4 g^{-1} soil when the amount of phosphorus increased from 30 to 60 kg ha^{-1}. The number of cyanobacterial population was estimated to be 63.57×10^4 g^{-1} soil ranking second in position among the treatments following 30 kg P and 60 kg N ha^{-1} applied together. This number, however, increased significantly to 74.47×10^4 g^{-1} soil when 60 kg N with 60 kg P applied per hectare together, attaining the highest among the treatments used . The number of cyanobacterial population reduced drastically to $41.67 \times 10^4 g^{-1}$ soils when 120 kg N and 60 kg P ha^{-1} was applied combindly and was found to be statistically significant.

Results showed that addition of phosphorus (0, 30, 60 kg P ha^{-1}) caused a significant increase in the propagation of cyanobacteria with the increase in the level of P over the control irrespective of the duration of sampling. In contrast, supplementation of nitrogen in the field resulted a nonsignificant depressive effect in the proliferation of cyanobacteria at 30, 60 and 90 days of transplantation with the increase in the level of applied nitrogen not only over the control but also between the N-treated plots.

Maximum retardation in the number of cyanobacteria was assessed in the plot treated with nitrogen (60 and 120 kg N ha^{-1}). However, this depressive situation was significantly improved due to addition of phosphorus at lower dose of nitrogen (60 kg N ha^{-1}). The positive interaction of phosphorus with nitrogen stimulated the growth of cyanobacteria significantly at all stages of sampling. However, the stimulative effect of phosphorus was found to be reduced at the highest rate of nitrogen when applied together. Moreover, the rates of phosphorus became leveled off in the presence of 120 kg N ha^{-1} resulting a nonsignificant variation in the number of cyanobacterial population. The number of cyanobacteria was found to increase with growth period up to 60 days and thereafter the population decreased at 90 days of transplantation of the crop.

Results obtained clearly demonstrated that application of N in the rice field significantly retarded the number of cyanobacteria enumerated in the location under investigation at 30, 60 and 90 days of transplantation of rice seedlings. Moreover, the decrease in number of the same cyanobacteria increased with the increase in amount of the nitrogenous fertilizer significantly in comparison to the control too. This suggests that enrichment of the soil with fertilizer-N inhibited the growth of cyanobacteria. The reason might be due to the fact that N_2- fixing cyanobacteria are profoundly favoured by a lack of competitiveness of the other algae and can proliferate profusely in soil poor in nitrogen content particularly in rice field imparting the fact that their NFA is retarded or at least affected to some extent. Similarly the selective action and inhibitory effect of added N-fertilizers on N_2-fixing BGA in rice fields of Ivory Coast was reported by other workers[6].

Addition of phosphorus, in contrast, encouraged the growth of cyanobacteria resulting a significant flush in their number irrespective of the duration of sampling intervals. The stimulative impact of P on the growth of cyanobacteria also increased with the increasing level significantly. This findings agreed favorably well with the observations of other investigators[7, 8]. The positive relationship of growth of BGA with the available P content of soil has also been demonstrated[4, 9-11].

Results revealed that the inhibitory effect of fertilizer N on the growth of cyanobacteria can be overcome significantly due to incorporation of phosphorus along with N-fertilizer. However, this positive intraction of P with N was found to be only statistically significant at lower dose of N i.e. 60 kg N ha^{-1}. The role of P became leveled off resulting an insignificant impact on the growth of cyanobacteria at the highest dose of N (120 kg N ha^{-1}). Nevertheless, it has been found that interaction of P with lower dose of N ($N_{60}P_{30}$, $N_{60}P_{60}$) was significantly better to promote the growth of cyanobacteria than the individual impact of lower dose of N i.e. 60 kg N ha^{-1} irrespective of sampling intervals. Notwithstanding the fact that the maximum number of cyanobacteria was enumerated in the treatment where **60 kg N together with 60 kg P ha^{-1}** was applied up to **90 days of transplantation** of rice seedlings .

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