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EFFECT OF BLUE-GREEN ALGAE AND UREA- N ON GROWTH AND YIELD PERFORMANCE OF TRADITIONAL VARIETY OF RICE

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Effect of blue-green algae (BGA) as biofertilizer and Urea-N on the growth and yield attributes of a traditional variety of rice (Nigersail) was investigated in the field for two consecutive T- Aman seasons. Application of recommended dose of N alone and in combination having 20 to 40% less N with BGA (*Nostoc spongiaeforme* Dh 164, *Nostoc commune* Dh 169, *Calothrix marchica* Dh 167 and *Stigonema* Dh 168) showed an identical impact on growth and yield characteristics of rice. Variations caused by the treatments in most of the cases were not statistically significant. However, inoculation of BGA with partial urea-N resulted better performance on growth and yield of rice signifying the contribution of BGA in N_2 fixation. Highest yield of rice grain was recorded in BGA inoculated plots irrespective of the seasons.

Keywords: Algalization; Blue-green algae; *Calothrix*; Growth; *Nostoc*; Rice; *Stigonema*; Yield.

Introduction

Continous use of chemical fertilizers in rice fields causes an adverse effect on the soil microflora and soil structure[1]. Application of biological nitrogen fixing agents may help significantly in overcoming these problems [1,2]. It is well established that some blue-green algae (BGA) are capable of fixing atmospheric nitrogen and help in maintaining rice-field soil fertility [3-7]. It has been estimated that successful inoculation of BGA can supplement upto 20-30 kg N/ha/crop [8-9]. In India the algalization technology has been reported to be successfull and that BGA as biofertilizer is provided to farmers for rice crop production [9,10]. However, the technology is largely dependent upon the establishment of efficient algal strains in rice fields. Application of BGA in rice-field soil would be very useful because of their capacity to metabolize the molecular nitrogen, liberate part of the fixed nitrogen and growth regulating extra cellular metabolites [11-13]. Besides, they help in solubilizing the insoluble phosphate, add organic matter and improve the physical and chemical nature of the soil [14-15]. The present investigation was carried out in two consecutive T-Aman seasons with an aim to see the effects of applied urea-N and BGA strains on growth and yield of a traditional variety of rice.

Material and Methods

Two field experiments were carried out at Taratpara, 4 km south-east of Bangladesh Rice Research Institute, Gazipur for two consecutive T-Aman seasons using Nagersail as a traditional variety of rice, grown during the year 1999 and 2000. Seedlings attaining the age of 50 days were transplanted in plots of 5 m^2. Five treatments each having four replications were distributed in a randomized complete block design.

The treatment combinations used were as follows:

$N_0P_0K_0\ S_0BGA_0$ (Control)
$N_{97}P_{18}K_{52}\ S_{18}BGA_0$ (RFD)
$N_{78}P_{18}K_{52}\ S_{18}BGA_1$ (minus 20% urea-N)
$N_{58}P_{18}K_{52}\ S_{18}BGA_1$ (minus 40% urea-N)
$N_{19}P_{18}K_{52}\ S_{18}BGA_0$ (minus 80% urea-N)

Nitrogen as urea, P as TSP, K as MP and S as gypsum (kg/ha) were applied. Nitrogen was applied in three equal installments. One-third of N together with TSP, MP and gypsum were applied as basal dose. The rest two-third of N was applied at 30 and 60 days of transplantation. However, extra amount of TSP was added in three equal splits i,e. 10, 20 and 30 DAT.

Inoculation of BGA - Nostoc spongiaeformae Dh164, *Nostoc commune* Dh169, *Calothrix marchica* Dh167 and *Stigonema* Dh168 were grown separately in plastic bowls keeping on window sill along with foam blocks of 1 cm^2 surface area. These strains were mixed on the day of inoculation with fresh foam (about 0.1m^2 foam-based BGA inocula were mixed with 0.3 m^2 fresh-foam blocks) and sprayed in micro plots, amounting to 1 kg dry BGA/ha.

Sixteen hills were collected, four from each micro plot to study the agronomic characters except the grain yield. Grain yield from each micro plot was determined after harvesting. Moisture content of the grains was

Table 1. Effects of blue-green algae and urea-N on the growth and yield of traditional variety of rice grown during T. Aman season in 1999.

Treatments	Tillers/hill	Panicles/hill	Panicle length (cm)	Sterility (%)	Wt. of 1000 grains (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
$N_0P_0K_0S_0BGA_0$	10.53 a	9.75 c	21.86 b	9.64 b	18.748 b	3003 b	2672 c
$N_{97}P_{18}K_{52}S_{18}BGA_0$	12.29 a	11.68 a	22.75 ab	13.59 ab	19.843a	3318 a	3991a
$N_{78}P_{18}K_{52}S_{18}BGA_1$	10.90 a	10.17 bc	22.17 ab	14.81 a	19.465 ab	3046 b	3344 b
$N_{58}P_{18}K_{52}S_{18}BGA_1$	11.33 a	10.50 abc	22.96 a	13.02 ab	18.903 ab	2847 b	3196 b
$N_{19}P_{18}K_{52}S_{18}BGA_0$	12.14 a	11.11 ab	23.12 a	9.92 b	18.975 ab	2988 b	3516 b

Means followed by a common letter are not significantly different at 5 % level by DMRT.

Table 2. Effects of blue-green algae and urea-N on the growth and yield of traditional variety of rice grown during T. Aman season in 2000.

Treatments	Tillers/hill	Panicles/hill	Panicle length (cm)	Sterility (%)	Wt. of 1000 grains (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
$N_0P_0K_0S_0BGA_0$	11.25 b	10.55 b	21.02 c	10.73 b	18.360 a	2598 c	2863 d
$N_{97}P_{18}K_{52}S_{18}BGA_0$	14.08 a	12.91 a	23.11 ab	17.47 a	18.393 a	3794 a	4527 a
$N_{78}P_{18}K_{52}S_{18}BGA_1$	12.78 ab	11.55 ab	22.86 ab	12.27 b	18.403 a	3830 a	4066 b
$N_{58}P_{18}K_{52}S_{18}BGA_1$	13.40 a	12.32 a	23.47 a	9.52 b	18.938 a	3869 a	4223 ab
$N_{19}P_{18}K_{52}S_{18}BGA_0$	12.61 ab	12.02 ab	21.91 bc	10.43 b	18.470 a	3081 b	3315 c

Means followed by a common letter are not significantly different at 5 % level by DMRT.

determined by Riceter L. PB-2106 kett standard Moisture metre and corrected to 14% in calculating the yield. Straw was oven dried at 80° C for 24 hours and weighed.

Results and Discussion

Results showed that recommended dose of urea-N resulted a significant increase in number of tillers/hill up to 25% over the control in the second year of cropping (Table 2). However, in the first cropping season, no such significant change in the growth attribute of number of tillers was observed due to applied treatments (Table 1). Addition of inoculum together with applied N caused an in general better performance to improve the number of tillers/ hill up to 3.5 to 7.9 % over the control in the year 1999. Contrary to this, 3.6 to 9.1% increase in number of tillers/ hill over the control was observed in the year 2000. Contribution of BGA was found to be better in the plot treated with lower level of N in either cropping seasons so far initiation of tillers is concerned (Tables1 2). Incorporation of higher amount of P (35kg/ ha) also increased the number of tillers/ hill and was statistically identical to that of algal treated ones irrespective of the cropping years. This possibly explains the contribution of P towards the proliferation of indigenous BGA which, in turn, accumulated molecular N_2 in the root rhizosphere and became available for growing rice plants.

Number of panicles/ hill of the crop also showed a significant increase due to application of recommended dose of urea-N over the control irrespective of the cropping years attaining the maximum among the treatments used (Tables 1-2). Plots treated with BGA revealed an identical variation in number of panicles/hill in both the experiments. Apart from cropping seasons, inoculation of BGA ascertained better role in panicle initiation ranging farm 3.2 to 6.7 % more in the plots supplemented with comparatively lower dose of N. In comparison to BGA treated plots, a decrease in applied N from 58 to 19 kg/ha (40 to 80% lower than recommended dose) with a concomitant increase in P from 18 to 35 kg /ha showed about 3.2 to 5.8% increase in number of panicles/hill in the first cropping season (Table 1). However, the variation was not statistically significant at all. Al most similar trend was followed in the experiment conducted in the subsequent year too (Table 2).

The results showed that application of N in association with BGA caused an increase in length of panicle over the control in some cases though not significantly in either years of cropping (Tables 1-2). Addition of BGA with lower dose of N and the treatment receiving the highest level of P resulted a significant increase in length of panicle ranging from 5.0 to 5.8% over the control in the first experiment although the variation between the BGA treatments was not significant (Table 1). Almost a reverse trend was observed in the following year (Table 2). Maximum length of panicle (23.47 cm) was attained by rice plants provided with BGA together with lower level of N indicating the better role of inoculum in comparison to that supplied with higher level of N in panicle formation through N_2 fixation.

Percent sterility of rice grain increased in most of the treatments as compared to control though not significantly (Tables 1-2). Sterility of grain generally decreased with the decrease in amount of applied N. Maximum sterility (17.47%) was recorded in the grain collected from the plots treated with the highest amount of N in the second cropping of rice (Table 2). However, BGA in combination with higher level of N showed the maximum percentage of sterility (14.81%) of rice grain in the first cropping season (Table 1). The result explains that encouragement of the indigenous BGA through additive means caused by judicious P-fertilization could reduce the sterility of rice grain appreciably.

Results presented on weight of 1000 grains of rice showed significant variation among the treatments applied in the field experiments conducted in two consecutive seasons (Tables 1-2). Only the recommended dose of N caused a significant increase in weight of 1000 grains over the control in the first cropping season. However, the treatments caused an in general increase in weight of 1000 grains over the control irrespective of the seasons. Lower level of N either alone or in conjunction with BGA in the paddy fields generally encouraged the filling of rice grain yielding the maximum weight of 1000 grains. These findings are in agreement with the results reported by Mian *et al*[16].

The change in yield of rice grain showed the similar reflection as in the case of weight of 1000 grains in the first cropping year (Table 1). The variation in yield of grain among the treatments was not statistically significant expect the recommended dose of N which showed the significantly best result (3318 kg/ha). In contrast, the amendments caused a marked and significant increase in yield of rice grain ranging from18.6% to 48.9% over the control in the second cropping season (Table 2). Inoculation of BGA played role in increasing yield of rice attaining the maximal. Lower dose of N again supported better for the activity of BGA in the rice field. The higher yield of rice recorded in algalized plots supplemented by partial supply of N might be due to the stimulated role played by extra cellular substances produced by these organisms [10, 15].

The picture pattern of yield of straw also showed an almost similar trend as in grain yield (Tables 1-2). The treatments caused a significant increase in yield of straw over the control in both the set of experiments. However, the variation among the treatments in most of the cases was found to be not significant. The highest yield of straw was recorded in the treatment receiving the highest level of N irrespective of the cropping reasons. No such definite change in the yield of straw was observed as evidenced from data collected over two consecutive seasons.

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