



## EFFECT OF CYANOBACTERIAL BIOFERTILIZER ON THE GROWTH AND YIELD COMPONENTS OF TWO HYV OF RICE

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### Abstract

Impact of blue-green algal inocula (cyanobacteria) and urea-N on the growth and yield components of two HYV of rice (BR-28, BR-29) grown in T. Aus and Boro seasons was investigated in the field. Application of 20 to 40% less fertilizer-N than recommended dose combined with cyanobacterial inoculum  $1 \text{ kg ha}^{-1}$ ; (*Nostoc spongiaeforme* Dh 164, *Nostoc commune* Dh 169, *Calothrix marchica* Dh 167 and *Stigonema* Dh 168) produced significantly higher number of tillers/hill, panicles/hill, length of panicle, weight of 1000 grains, and yields of grain and straw as compared to the control. However, in most of the cases, agronomic characters and yield components in algalized plots were statistically identical to the treatment with recommended dose of N. The best role was achieved by cyanobacterial inocula in presence of 40% less fertilizer-N to stimulate the growth and yield attributes of both varieties of rice signifying the better contribution of cyanobacterial inoculum in rice field ecosystem relatively low in N content.

**Key words:** *Nostoc*, *Stigonema*, *Calothrix*, Cyanobacterialization, Growth, Yield, HYV rice.

### Introduction

The input of fertilizers is an inevitable and basic requirement of modern intensive rice farming because of increased demand of nutrients of the high yielding varieties. Of the fertilizers, nitrogen being an essential element deserves the vital position. Physiologically it plays the key role and

has been considered as a yield limiting factor. However, increased cost of the fertilizer is becoming an economic constrains for the farmers of the developing countries like Bangladesh. Moreover, the continuous use of chemical fertilizers causes the ecological and biochemical imbalance in the rice field

(Roger and Kulasooriya, 1980). As a consequence, to overcome this dual problems, the concepts of biofertilizers is recently being gaining momentum and is successfully practiced in rice field in many countries like India, China and Uganda. The significant contribution of blue-green algae as an alternative source of nitrogen particularly in the rice field has long past history (De, 1939). The algalization technology has been reported to be successful to a great extent in India (Vankataraman, 1979, 1992; Kaushik, 2000). Literature review shows that very limited works have been done in this area in Bangladesh. (Begum *et al.* 1996).

Therefore, an attempt has been made to follow the impact of cyanobacterial inoculum in presence of partial supply of fertilizer-N on the growth and yield components of two HYV of rice in the field.

## Materials and Methods

Experiments were conducted in the field 4 km south-east of Bangladesh Rice Research Institute, Gazipur during T-Aus and Boro seasons using two High Yielding Varieties (HYV) of rice namely BR-28 and BR-29 as the test crop to evaluate their response to applied cyanobacterial inoculum and urea-N at different combinations. Thirty days old rice seedlings of uniform health and size were transplanted in experimental plots of 5 m<sup>2</sup> at the rate of 3 seedlings/hill and the hill to hill distance maintained was 6 inches. The treatments used (kg ha<sup>-1</sup>) were N<sub>0</sub>P<sub>0</sub>K<sub>0</sub>S<sub>0</sub> inoculum<sub>0</sub> (control), N<sub>97</sub>P<sub>18</sub>K<sub>52</sub>S<sub>18</sub> inoculum<sub>0</sub> (RFD), N<sub>78</sub>P<sub>18</sub>K<sub>52</sub>S<sub>18</sub> inoculum<sub>1</sub> (minus 20% urea N), N<sub>58</sub>P<sub>18</sub>K<sub>52</sub>S<sub>18</sub> inoculum<sub>1</sub> (minus 40% urea-N) and N<sub>19</sub>P<sub>35</sub>K<sub>52</sub>S<sub>18</sub> inoculum<sub>0</sub> (minus 80% urea-N). Treatments were arranged following a randomized block design with four replications. Agronomic practices were done whenever required up to maturity of the crop.

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Fertilizers were applied as urea-N, TSP-P, MP-K and gypsum-S. One-third of N together with PKS were applied at final land preparation. The rest two-third of N was incorporated in three equal instalments at 30 and 60 days of transplantation. However, the extra amount of P was added in three equal splits at 10, 20, and 30 days transplantation.

### **Inoculation of Cyanobacterial Inoculum**

Species of *Nostoc spongiaeformae* Dh 164, *Nostoc commune* Dh 169, *Calothrix marchica* Dh 167 and *Stigonema* Dh 168 were grown in plastic bowls separately keeping on window sill along with foam blocks of 1 cm<sup>2</sup> surface area. All the strains were mixed on the day of inoculation with fresh foam (about 0.1 m<sup>2</sup> foam-based inocula were mixed with 0.3

m<sup>2</sup> fresh-foam blocks) and spread on designed plots at the rate 1 kg dry inocula ha<sup>-1</sup>.

Agronomic parameters were recorded following collection of four hills from each plot. Grain yield was, however, recorded at harvest. Riceter L. PB-2106 kett standard moisture meter was used to estimate the moisture content of the grains and corrected to 14% in calculating the yield. The weight of oven dried (80°C for 24 hours) straw was also measured.

### **Results**

The growth and yield of two HYV rice namely BR-28 and BR-29 as influenced by applied cyanobacterial inoculum and urea-N in the field have been observed and the results thus obtained are presented in Tables 1 and 2.

**Table 1. Effects of cyanobacteria and urea-N on growth and yield characteristics of HYV rice (BR-28) grown in T. Aus season.**

Treatments (kg ha <sup>-1</sup> )	Panicles/hill	Panicle length (cm)	Sterility (%)	Wt. of 1000 grains (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> S <sub>0</sub> BGA <sub>0</sub>	9.00 ab	19.47 b	22.11 a	19.955 b	2217 c	2661 a
N <sub>97</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>0</sub>	10.59 ab	21.56 a	19.74 a	19.915 b	3620 a	4051 ab
N <sub>78</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>1</sub>	9.61 ab	21.37 a	19.92 a	20.238 ab	3038 a	3366 bc
N <sub>58</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>1</sub>	11.05 a	21.45 a	22.42 a	21.073 a	3573 a	4152 a
N <sub>19</sub> P <sub>35</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>0</sub>	8.64 b	20.40 ab	19.87 a	20.490 ab	2577 c	3092 c

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

**Table 2. Effects of cyanobacteria and urea-N on growth and yield characteristics of HYV rice (BR-29) grown in Boro season.**

Treatments (kg ha <sup>-1</sup> )	Tillers/hill	Panicles/ hill	Panicle length (cm)	Sterility (%)	Wt. of 1000 grains (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> S <sub>0</sub> BGA <sub>0</sub>	8.22 b	7.98 b	22.92 a	29.71 a	19.675 ab	3134 b	2417 a
N <sub>97</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>0</sub>	10.83 a	10.57 a	22.78 a	30.19 a	20.505 ab	5227 a	3985 bc
N <sub>78</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>1</sub>	10.37 a	10.06 a	23.30 a	26.95 a	19.818 ab	5001 a	3744 b
N <sub>58</sub> P <sub>18</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>1</sub>	11.75 a	10.33 a	23.22 a	31.97 a	20.700 a	5518 a	4997 bc
N <sub>19</sub> P <sub>35</sub> K <sub>52</sub> S <sub>18</sub> BGA <sub>0</sub>	10.73 a	10.42 a	23.19 a	33.49 a	19.510 b	5484 a	4600 bc

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

The effects of the treatments on number of tillers and panicles/hill of BR-28 showed an in general increase over the control but

not significant among themselves (Table 1). The only significant variation in these growth attributes was found in treatments receiving cyanobacterial inoculum

supplemented with lowest dose of N and highest level of P provided with no inoculum among the treatments used.

Contrary to this, the treatments, however, revealed a significant increase in both the growth components of BR-29 over the control (Table 2). Furthermore, the variation among the treatments was not found to be statistically significant at all. It could be noted that algal inoculum provided with lowest level of urea-N exerted the best effect to promote the number of tillers (12.15, 11.75) and panicles (11.05, 11.33)/hill attaining the maximum in both the HYV of rice under study.

Panicle length of BR-28 variety of rice increased significantly due to applied cyanobacterial inoculum with urea-N and recommended dose of fertilizers over the control (Table 1). However, the variation among the treatments was not significant at any level of probability. A reverse trend was observed in case of BR-29 variety of

rice showing no significant effectiveness of the treatments except a slight increase in length of panicle in comparison to the control (Table 2). The maximum length of panicle (BR-28, 21.45 cm; BR-29, 23.30 cm) covered by both the varieties of rice plants was collected from the plots treated with cyanobacterial inoculum.

Percent sterility of grains generally decreased in BR-28 and increased in BR-29 variety of rice due to use of cyanobacterial inoculum and fertilizers (Tables 1-2). However, the overall impact of the amendments was not statistically significant. Maximum sterility was recorded to be 22.42 and 31.97% for BR-28 and BR-29, respectively, counted from panicles of rice plants provided with inoculum together with lower level of N.

Similarly, addition of inoculum and fertilizers showed an increase in weight of 1000 grains of BR-28 and BR-29 varieties of rice (Tables 1-2). The variation in increase in weight of 1000 grains was

found to be statistically insignificant in most of the cases. Highest weight of 1000 grains of rice was achieved by BR-28 (21.073 g) and BR-29 (20.700 g) due to combined treatment of cyanobacterial inoculum and lower level of N indicating the significance of the inoculum to improve the yield attribute of weight of 1000 grains of rice in either varieties.

The grain yield of both BR-28 and BR-29 varieties of rice increased significantly due to application of the inoculum with N and recommended dose of fertilizers significantly over the control (Tables 1-2). However, the variation in yield of rice among the treatments was not significant rather the yields were very much identical. Supply of the inoculum with lower level N played the best role to improve the yield of rice grain to maximal recording up to 5518 kg/ha in BR-29. The same treatment, however, produced the second highest yield of rice grain (3573 kg/ha) in case of BR-28 which is identical to the highest

yield (3620 kg/ha) modified by recommended dose of fertilizers (Table 1).

Cyanobacterial inoculum along with lowest dose of N increased the yield of grains from 17.6 to 61.2 and 0.6 to 76.1% over the other treatments in BR-28 and BR-29 varieties of rice, respectively. This possibly explains the better efficiency of the inoculum in improving the yield of rice through accumulation of  $N_2$  in soil relatively low in N content. Higher rate of P in absence of inoculum produced the identical and second highest yield of rice grain (5484 kg/ha) in BR-29 variety of rice. The reason might be due to the fact that increased supplementation of available P possibly promoted and stimulated the activity of the indigenous cyanobacteria (blue-green algae) in the rice field which, in turn, favoured the yield of grain through increased supply of  $N_2$  to the rice plants in available form.

Yield of straw increased significantly due to addition of recommended dose of

fertilizers and the inoculum with lowest level of N in BR-28 variety of rice (Table 1). In contrast, treatments caused a significant increase in yield of straw over the control in BR-29 (Table 2). However, the variation among the treatments was identical and not statistically significant. The yield reflection of straw was similar to that of grain yield in either varieties of rice (Tables 1-2). Added cyanobacterial inoculum again showed its better performance to modify the yield of straw in presence of lower level of N in both the varieties of HYV rice.

### Discussion

The results suggest that application of cyanobacteria with lower level of applied urea-N was effective in enhancing the growth attributes of rice plant. This indicates the better efficiency of cyanobacteria in promoting the growth of rice plants in soil low in nitrogen fertility. Similar information in increasing the number of tillers of rice due to cyanobacteria has also been advanced by

other investigators (Aiyer *et al.*, 1972; Singh 1961; Subrahmanyam and Manna 1966; Watanabe 1962). It could be noted that cyanobacterialization was found to be much more effective in T. Aus season to reduce the sterility of rice grain though not significantly during both the seasons of cultivation. Reports are also available that effective cyanobacterialization could increase the yield of rice grain significantly. Similarly Jalapathi *et al.* (1977) also reported the positive effect of cyanobacterialization on reduction of sterility of rice grain. The stimulative and profoundly significant impact of cyanobacterialization through use of cyanobacteria was found to be evident on yield of grain of both the varieties of rice over the control irrespective of the seasons. This findings corroborated well with the observations of Hosda and Takta (1955), Sundara *et al.* (1963) and Venkataraman and Goyal (1963) who reported the significant contribution of cyanobacteria in boosting up the yield of

rice grain particularly in low land rice field. Similarly, stimulative effect of algalization on yield of straw have also been reported by Sundra *et al.* (1963) and Venkataraman and Goyal (1963).

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