RECENT POSITION OF ALGALIZATION TECHNOLOGY IN BANGLADESH

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Abstract

Both greenhouse and field experiments showed that biologically potent blue-green algae (viz. *Calothrix marchica*, a pigment mutant of *C. marchica*, *C. javanica*, *Cylindrospermum* sp., *Scytonema* sp., *Anabaena variabilis*, *Nostoc* sp., *Tolypothrix* sp., *Phormidium* sp., *Aulosira fertilissima* and *Westiellopsis prolifica*) capable of fixing indigenous nitrogen could improve the yield of BR-3 rice significantly. Some of these algae are very effective and their application @ 10 kg ha^{-1} could increase the yield up to 20.58%. Addition of 10 kg algae ha^{-1} was significantly better than 40 kg N ha^{-1} in rice production. However, their combined application could raise the yield up to 44.67%. The efficiency of the algae was reduced in the presence of N-fertilizer @ 60 kg ha^{-1}. The residual impact of the blue-green algae was also appreciable to stimulate the growth and yield of rice.

Introduction

Now-a-days, there is no doubt about the significance of commercial fertilizers particularly nitrogen in increasing the yield of crops in intensive farming. However, increasing cost of chemical fertilizers limits their use for the poor farmers of the developing countries. Consequence upon this, the agronomists attempted to utilize the indigenous source of blue-green algae successfully as an alternative source of nitrogen in rice field to fix atmospheric nitrogen (Subrahmanyan, 1965; Watanabe, 1960; 1978). Experimentally found that blue-green algae could contribute significantly to stimulate the nitrogen economy of rice soil up to 20-30 kg N ha^{-1} $crop^{-1}$ with an increase in 10-

20% grain yield (Agarwal, 1979; Venkataraman, 1976, 1981; Roger and Watanabe, 1982). Nevertheless, the stimulatory effect of some essential growth promoting substances for rice plants secreted by them cannot be overlooked (Subrahmanyan *et al.*, 1965; Shukla and Gupta, 1967; Singh and Trehan, 1973). Venkataraman (1977) proposed that judicious application and utilization of blue-green algae in the rice field will not only be an economic advantage but also a strategic necessity so far rice production and nitrogen fertility is concerned.

A significant proportion of agricultural land in Bangladesh is under rice cultivation and deficient in nitrogen. Moreover, the major rice growing soils are water-logged and under prevailing humid tropical climatic conditions the nitrogen fixing blue-green alage are most operative. Therefore, the utilization of blue-green algae as a supplement of fertilizer nitrogen could undoubtedly be of economic significance for rice cultivation in a developing country like Bangladesh.

Attempts were, therefore, made to assess the contribution of blue-green algae in both green-house and field experiments together with their residual impact on the growth and yield of high yielding variety of rice.

Materials and Methods

The impact of blue-green algae on rice was examined in three separate experiments.

Experiment I

A greenhouse experiment was conducted with 28 days old rice seedlings of HYV BR-3. Four different blue-green algae (*Calothrix marchica*, a pigment mutant of *C. marchica*, *Cylindrospermum* sp. and *Scytonema* sp.) in the absence and presence of NPK fertilizers (112:96:67 kg ha^{-1}) were used in the experiment. 1 mg of each of the blue-green algae was added in each treatment before 2 days of transplantation. The experiment was done

following a completely randomized design with three replications.

Experiment II

The field experiment was carried out in a non-calcareous dark grey flood plain soil of Bangladesh Agricultural University, Mymensingh. Six soil based culture of blue-green algae namely *Anabaena* sp., *Tolypothrix* sp., *Nostoc* sp., *Scytonema* sp., *Phormidium* sp. and *Calothrix* sp., were selected. Two levels of algal inocula (0, 10 kg ha^{-1}) and three doses of N as urea (0,40,60 kg ha^{-1}) in all possible combinations were applied with a basal dose of 25 kg P (TSP). Half of the N was applied at the time of seed bed preparation and the rest half in two equal splits after 14 and 45 days of transplanting. Algal inocula was broadcasted after 7 days of transplanting. Thirty three days old rice seedlings were transplanted at the rate of 2 $hill^{-1}$. Six treatments, in triplicate, were arranged in a randomized block design. Rate of algae and preparation of inocula were made as per recommendation of Venkataraman (1976, 1977).

Experiment III

This pot culture experiment was performed to assess the residual effect of a mixture of *Anabaena variabilis*, *Aulosira fertilissima*, *Scytonema* sp., *Calothrix javanica* and *Westiellopsis prolifica* on rice. Urea (0, 45 kg ha^{-1}) and algae (0, 2 g pot^{-1}) in all possible combinations together with a basal dose of P (TSP) and K (MP) @ 27 and 36 kg ha^{-1}, respectively, were applied. Half of N was added at the time of mixing the soil and the rest before panicle initiation. The soil was mixed thoroughly with NPK fertilizers before potting. Two rice seedlings (BR-3, 28 days old) were transplanted in each pot. Algal inocula were added after 7 days of transplantation. Four treatments were arranged in a completely randomized design with four blocks.

Results and Discussion

The results of the first preliminary experiment shows that application of blue-green algae caused a significant increase in yield of rice over the control (Table I). Yield of grain was significantly better in pots receiving both algae and NPK

Table-I. Effect of NPK and blue-green algae on BR-3 rice.

Treatments	No. of panicle^{-1}	No. of Grain pot^{-1}	Soil grain g pot^{-1}	grain yield N %
Control	91	109	6.6	0.56
Fertilizer	110	3080	18.0	0.79
Fert. + *Cylindro-spermum* sp.	12	3920	23.8	0.97
Fert. + *Scytonema* sp.	114	3762	22.8	0.97
Fert. + blue-green mutant of *Calothrix marchica*	132	3696	12.4	0.78
Fert. + *Calothrix marchica.*	119	3927	22.8	0.97
LSD at 5% level	5.5	78.7	2.8	0.003

Begum and Islam (1982)

fertilizers than NPK fertilizers alone. An almost similar trend was observed in nitrogen content of the soil after harvesting (Table I). This indicates that the efficiency of blue-green algae was significantly increased in the presence of fertilizers to improve the yield and nitrogen fertility of the soil. Possibly, P fertilizer stimulated the activity of blue-green algae to fix nitrogen which ultimately contributed to increase the

production of grain (Srinivasan, 1978). It is noted that with fertilizers, the best efficiency was recorded by *Calothrix marchica* and *Cylindrospermum* sp. The order of their efficiency was *Calothrix marchica* = *Cylindrospermum* sp.> *Scytonema* sp.> blue-green mutant of *Calothrix marchica*.

The results of the field experiment shows a very good agreement with the findings of the preliminary greenhouse experiment (Tables I and II). Algal inoculation caused a significant increase in growth and yield contributing characters of rice (Table II). Inocula alone showed significantly better response to increase the yield of grain than 40 kg N ha^{-1}. The efficiency of the algal inocula became nonsignificant when compared with the yield obtained at 60 kg N ha^{-1}. Maximum yield (5819.34 kg ha^{-1}) was recorded when 10 kg blue-green algae was combined with 40 kg N ha^{-1} resulting an increase up to 44.7%. Such favourable effect of blue-green algae in increasing yield of rice was also reported by other investigators of the rice growing country (Lay, 1959; Singh, 1961 Sankaram, 1971; Subrahmanyan, 1972; Pantastico and Gonzales, 1976; Venkataraman, 1977; Islam *et al.*, 1984). Algalization increased the yield of rice from 20.6 to 44.7%. This is in good agreement with the findings of De and Sulaiman (1950), Islam *et al.* (1984) and Mannan *et al.* (1986).

Table II. Effect of urea and algal inocula on growth and yield of BR-3 rice.

Treatments	Tillers $hill^{-1}$	Filled grain $panicle^{-1}$	Grain yield kg ha^{-1}
N_0BGA_0	10.4 bc	80.1 dc	4022.46 e
N_0BGA_{10}	11.7 bc	87.7 abc	4860.37 c
$N_{40}BGA_0$	11.4 bc	93.8 bc	4354.36 d
$N_{40}BGA_{10}$	15.5 a	104.4 a	5819.34 a
$N_{60}BGA_0$	10.2 c	73.3 c	4635.56 c
$N_{60}BGA_{10}$	12.0 abc	92.2 ac	5347.31 b

BGA = Blue-green algae

Letter or letters in common in a column do not differ significantly at 1% level.

Bhuiya *et al.* (1984)

Algae are living systems and once they establish themselves in the soil their biological activity continues. An appreciable population of algae can be built up if the application of algal inoculum is continued for three or four consecutive cropping seasons. The benefit of residual effect of algalization can be availed for subsequent seasons without any further inoculation unless some unfavourable ecological conditions interact.

Table III shows that due to algalization, the yield of grain increased significantly (Table III). Such increase was attributed to the stimulatory role played by the biologically potent substances produced by these organisms (Sahay, 1966;

Table-III. Residual effect of blue-green algae on growth and yield of BR-3 rice.

Treatments	Grain	Grain		Straw	
	g pot^{-1}	g pot^{-1}		g pot^{-1}	
	Boro	Boro	t.Aman	Boro	t. Aman
	1981	1982		1982	
Control	15.2	18.5	23.4	19.8	23.5
Urea	2.9	24.5	24.5	26.4	30.2
Algae	25.6	27.1	43.1	26.1	30.6
Urea + Algae	32.3 32.2	35.9	50.3	29.3	
LSD (5%)	4.33	3.62	0.53	5.39	2.96

Begum *et al.* (1990)

Huang. 1978: Venkataraman. 1981: Patel *et al.*, 1984). Arora (1969) reported that excretion of organic acids by *Anabaena* sp. and *Tolypothrix tenuis* caused the increase in the availability of phoshorus to rice plants and thereby yield. Yield of straw increased significantly with algal inoculum alone in the subsequent years (Table III).

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