Response of BGA-Urea Fertigation as N_2 Source on Growth Parameters and Yield of Paddy (*Oryza sativa* L.) in Agra (India)

Guru Prasad Satsangi and Sanjay Yadav

Abstract—Paddy being cultivated since about 10,000 years B.C in Ganga Valley in India, its production reached up to 99 million tons in the year 2012. BGA are of much ecological importance for maintaining the soil fertility and reclaiming the alkalinity. In present investigation attempts were made to identify the local cyanobacterial genera from the paddy fields, BGA application for green farming enabling the paddy to utilize more amount of nitrogen released and to examine its impact along with Urea upon growth and yield responses of the Paddy crop. It was observed that combined treatment of BGA with Urea proved better response in almost all growth parameters and yield attributes except number of tillers/ Plant and grains/ panicle as compared to application of either Urea or BGA alone. The Paddy growers should be encouraged to adopt BGA along with Urea as source of Nitrogen for Paddy cultivation.

Keywords—BGA/Urea fertigation, Response, Paddy.

I. INTRODUCTION

THE fast growing economy of India demands for sustainable food crop management. Agriculture plays significant role and sharing the Indian economy. India has been passed 65 year of its independence, still small or marginal farmers time to time face the non availability of chemical fertilizers at reasonable prices. This problem recognized as one of the limiting factor in rice production, on the other hand, the excessive use of chemicals (herbicides and pesticides and fertilizers) are causing environmental problems presently and will affect the environment in near future also [2]. Rice and Wheat are widely cultivated food crops providing meal, income and employment to millions of rural growers and consumers [5]-[8]. The green revolution technology including high yielding varieties, massive use of chemical fertilizer and irrigated area expansion, increased the yield of both wheat and rice crops leading the extent of 23% in total food grain production of India [5]. The increasing cost of chemical fertilizers has meant that alternative biological sources of nitrogen for optimum crop production are rapidly gaining the importance [9]. In the rice field ecosystems, several nitrogen fixing BGA (Cyanobacteria) offer the most promising biological potential and not only contribute but also benefit the crop in many other ways.

Guru Prasad Satsangi is Professor with the Agricultural Operation in Dayalbagh Educational Institute, Dayalbagh, Agra -282110 India. (phone: 91 562 2821545, 91 9917026134 E.Mail: gurupsatsangi@gmail.com)

Sanjay Yadav is Research Scholar (Botany) with the Dayalbagh Eductional Institute,Dayalbagh, Agra -282110 India.(phone: 91 9582946004; e-mail: sanjaydei84@gmail.com).

Blue green algae belong to division Cyanophyta and single class Cyanophyceae or Myxophyceae, constitute the largest, most diverse and widely distributed group of prokaryotes that performs oxygenic photosynthesis. Several genera can fix atmospheric nitrogen and thus contribute the maintaining the fertility of natural and cultivated ecosystems especially wetland rice fields [9]. Paddy is mainly grown under water logged conditions where N2 fertilizer efficiency is low due to large nitrogen losses from flooded soils [3], in such conditions crop utilizes only about 1/3rd amount of nitrogen fertilizers have been applied, so it is essential to develop such a system which is the most potential habitats for cyanobacterial growth, capable of nitrogen fixation. The significant role of BGA in maintaining soil fertility and their distribution in Indian rice fields have been studied by various workers during past half century [1], [10], [12]. The most common species found Anabaena, Aulosira, Calothrix, Cylindrospermum, Gloeocapsa, Nostoc, Rivularia, Sytonema and Tolypothrix etc respectively [14].

Presently, only little information is available on algalization, regarding the ecological aspects in relation to soil, where cyanobacteria are extensively used as bio-fertilizer. An urgent need, therefore, requires for more studies on BGA to promote suitable recommendations to agriculturists on the use of specific algal strain as bio-fertilizers. Thus, in present investigation main emphasis was given on the isolation, identification and culturing of cyanobacteria from saline soil of local areas.

II. MATERIALS AND METHOD

Identification of BGA Flora: Surface crust samples were collected from the upper 0.5c.m. of dry soils from different locations of Agra district (U.P.) during the Kharif season of 2010. After mixing the core samples the composite samples were used to prepare the suspension dilution (10-1) of tested soil samples by suspending 10gm soil in 90ml distilled water. 1ml from soil dilution of each tested soil samples were transferred to BG-11 liquid culture medium [11], with or without combined nitrogen source. The cultures were incubated at $25\pm1^{o}C$ under continuous light from florescent tubes.

Identification of cyanobacterial strains were carried out using the Taxonomic publication of [4]. The field experiment was conducted in micro plots ($1m^2$ size) at DEI agricultural farm. Four treatments; nitrogen dose by urea alone (T1), with

BGA alone (T2), combination of BGA and Urea (T3) and soil without application of cyanobacterial fertilizer or Urea was considered as control (T4) in its three replications. The BGA biofertilizer, procured from National Facility for Utilization and Conservation of Blue Green Algae, Division of Microbiology, IARI, New Delhi. All recommended agronomic practices were adopted as the requirement of the rice crop in all experimental plots. Soil samples were analyzed for physicochemical properties viz., pH, electrical conductivity, texture, water holding capacity, C/N ratio. All observations were recorded at successive stages of growth and harvest of the crop and analyzed statistically.

II. RESULTS AND DISCUSSION

Paddy fields are temporary wetland ecosystems, having variable BGA biodiversity, therefore requires focused efforts to understand the ecology of Blue green algae in soil-plant interface [7]. A pH range of 7.9-8.2 was observed in all studied sites. During course of present investigation cyanobacterial genera i.e., Cylindrospermum, Aphanocapsa, Chroococus, Gloeothece, Aulosira, Nostoc, Anabaena, Oscillatoria, Calothrix, Westiellopsis, Tolypothrix and Scytonema were identified from paddy fields of studied areas (Table I).

TABLE I
SOIL PARAMETERS AND ISOLATED ALGAL POPULATION OF THE STUDIED AREA

Sample	pH	EC	P %	C/N ratio	BGA Genera
A	8.0	1.9	0.004	8.45	Aulosira, Nostoc, Anabaena, Oscillatoria, Scytonema, Calothrix, Westiellopsis, Tolypothrix, Scytonema
B	8.2	2.3	0.009	9.2	Aulosira, Anabaena, Plectonema, Nostoc, Cylindrospermum, Chroococus, Tolypothrix, Scytonema
C	7.9	1.8	0.0082	8.83	Anabaena, Nostoc, Chroococus, Aphanocapsa, Oscillatoria, Scytonema
D	7.8	2.2	0.0085	9.44	Aulosira, Nostoc, Anabaena, Oscillatoria, Scytonema, Chroococus, Westiellopsis, Tolypothrix

The distribution frequency of isolated genera in all studied sites was recorded as Nostoc sp. (30%) > Aulosira sp. (28%) > Anabaena sp. (21%) > Chrococcus turgitus & Cylindrospermum sp. (4%) > Aphanothece sp. & Oscillatoria sp. (3%) > Goethece rupestris & Westilopsis sp. (2%) > Plectonema sp. (1%) respectively (Fig. 1). Reference [9] also reported frequent distribution of heterocystous BGA of more than 95% in rice fields, even in dry season.
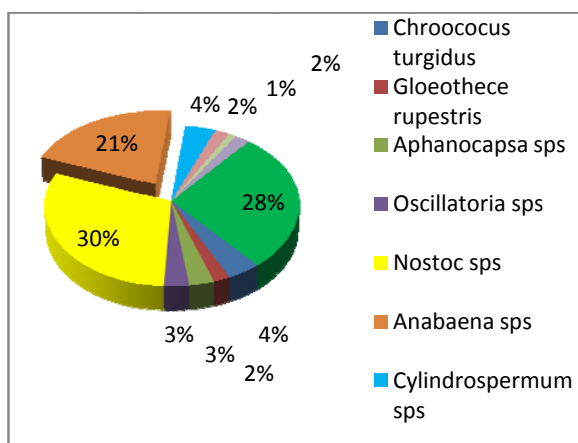

Fig. 1 Prevalence of cyanobacterial distribution in studied sites

TABLE II
IMPACT OF DIFFERENT TREATMENTS FOR N_2 POTENTIAL ON THE GROWTH AND YIELD OF PADDY

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Number of tillers/plant	2.00± 0.87	10.67±4.20	15.00± 2.06	5.00±1.66
Plant Height (cm)				
i. 30 DAT	44.32±3.22	54.44±8.78	61.22±12.88	26.34±2.07
ii. Before harvesting (120 DAT)	78.33±8.45	85.66±5.76	88.24±4.67	43.33±8.45
Plant population/m^2	71.33±3.44	58.54±8.45	66.47±2.44	48.32±6.45
Number of Panicle/plant	158.56±6.68	182.44±21.10	175.32±22.34	132.54±2.66
Grains/Panicle (no.)	84.67±1.22	82.12±3.34	62.27±12.45	48.66±8.34
Weight of 1000 grains (gm.)	19.66±2.88	18.78±1.67	26.22±1.44	12.33±2.55

Table II shows the impact of different treatments on the growth and yield of Paddy under field conditions. Results indicated that treatment T3 (combined dose of BGA + Urea) was found as better in almost all the growth parameters as compared to treatment T2 followed by treatment T3 and T4. Maximum plant population (71.33/m^2) and grains/panicle (84.67) was found when dose of Urea alone (T1) was applied.

On the other hand maximum number of panicle/plant was found in the treatment T2 (BGA alone).The reason behind this may be because of quick and faster vegetative growth of rice plants at initial stage. In case of height of plants and number of panicles with treatment 2 (BGA alone) responded best result rather than other treatments significantly. Thus it can be concluded that however, at initial stage, the urea is more

effective but in general. The use of urea and BGA in combination affects the plant growth better than the either urea alone or BGA alone respectively.

The trend of yield attributes also indicate that treatment4 was found to be more effective on almost all attributes except in case of number of grains/panicle which was mostly affected by treatment 2 (Urea alone). Surprisingly the response of Urea and BGA was found least for this attribute. The variation obtained over control was found to be highly significant [13].

The result further indicates that treatment 4 (application of nitrogen in the form of BGA and Urea both) is far superior to other treatments in respect of weight of 1000 grains. This is just possible that at initial stage, more numbers of panicles may be developed due to Urea application but due to excessive number of panicles, only healthier and stronger panicles could be survived .Rest of other panicles would have lost due to their week structure or any other factor.

III. CONCLUSION

Thus, it can be concluded that combined application of BGA and Urea proved better response in almost all analyzed growth as well as yield parameters of Paddy crop under field conditions. It is further suggested that local poor farmers should be encouraged to adopt combined fertigation of BGA and Urea to obtain better yield of rice at low inputs as compared to use of high amount of Chemical N_2 fertilizers, which is harmful to mankind as well as our environment.

ACKNOWLEDGMENT

REFERENCES

[1] R. S. Aiyer, , S. Shlahuddin, And G. S. Venkataraman, (1972). Long Term Algalization Field Trails With High Yielding Rice Varieties: Yield And Economics. J. Agric. Sci., 42, 382.

[2] M. Chung, K.. H. Kim, J. K. Ahn,, H.J. Ju, (1997). Allellopathic Potential Evaluation Of Rice Cultivars On Echinochloa Crus-Galli. Korean Weed Sci., 17, 52-58.

[3] S.K.,De Datta.,R.J. Buresh, (1989). Integrated Nitrogen Management In Irrigated Rice. Adv. Soil Sci., 10: 143-169.

[4] T.V. Desikachary, (1959), Cyanophyta, Indian Council Of Agricultural Research, New Delhi, India.

[5] B. S. Dwivedi, A. K. Shukla, V. K. Singh, R. L. Yadav, (2003),Improving Nitrogen And Phosphorus Use Efficiencies Through Inclusion Of Forage Cowpea In The Rice– Wheat System In The Indo Gangetic Plains Of India, Field Crops Res., 84, Pp. 399–418.

[6] M. L. Jackson,(1973) Soil Chemical Analysis, Prentice Hall Of India Pvt. Ltd., New Delhi., India.

[7] R. Prasanna And S. Nayak. (2007),Influence Of Diverse Rice Soil Ecologies On Cyanobacterial Diversity And Abundance, Wetlands Ecol Manage, 15, Pp. 127– 134.

[8] R.S. Paroda, T. Woodhead, R.B. Singh,(1994). Sustainability Of Rice-Wheat Production System In Asia, Vol. Ii. Rapa Publication, Bangkok, Thailand.

[9] P.A.Roger, S.A. Kulasooriya, (1980). Blue Green Algae And Rice. The Irri, Los Banos, Philippines, Pp. 112.

[10] C. Shukla, (1971). Systematic Descriptions Of Algae From The Rice Fields, Kanpur, India. Rev. Algal, 10, 257–270.

[11] R. Y. Stanier, R. Kunisawa, M. Mandel, Cohen Bazire, G.,(1971). Purification And Properties Of Unicellular Blue Green Algae (Order Chroococales), Bacteriol Rev., 35, Pp. 171-205.

[12] G. L. Tiwari, And R. S. Pandey. (1976). A Study Of The Bga From Paddy Field Soils Of India Iii. Nostacaceae. Nova Hedwigia, 27, 701–730

[13] G.P.Satsangi,V.P.Bhatnagar And J,N. Shrivastava(2002) Effect Of Bga/Urea As Nitrogen Application On Growth And Yield Responses Of Paddy(Oryza Sativa) In Agra District J.Liv.World Vol9 No.1 Pp5-13

[14] G.S.Venkatraman(1975)The Role Of Blue Green Algae In Tropical Rice Cultivation.In Nitrogen Fixation By Free Living Microorganisns(Ed. Stevart,W.D.P.) Cambridge University Press, Cambridge, U.K.,Pp.701-730.