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RESEARCH ARTICLE

Role of biofertilizer (BGA) & nitrogenous fertilizer on grain yield, nitrogen content & nitrate reductase activity of two rice (*Oryza sativa*) varieties jaya & sarju-52

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ABSTRACT

In recent years, biofertilizers have emerged as a promising component of the integrated nutrient supply system in Indian agriculture. Among biofertilizers benefiting cereal crop production, blue-green algae are very important. Studies were carried out during Kharif season at the agriculture Research Station of Nawabganj Bareilly. Application of BGA @ 12.5 kg/ha in combination with 80 kg/ha as urea recorded favourable results in the two varieties Jaya and Sarju-52 and it is comparable with grain yield, nitrogen content and nitrate reductase activity in leaves at the recommended dose of 160 kg/ha. Thus, it may be concluded that further increment in nitrogen along with blue-green algae is not beneficial in rice crop and it can save at least 40 KgN/ha/year with increased yield.

Key words: Biofertilizer; Blue-green Algae; Nitrogen; Grain yield; Nitrate Reducates Activity; *Oryza sativa*

1) INTRODUCTION

The God Shiva called rice *Vrihi* in Sanskrit. India is one of the original centers of rice cultivation. The rice harvesting area in India is the world largest. The national growth mask variability in the performance of different states but in the regions with the greatest in categories are discernible. The first category includes states of area that have an exceptionally high agricultural growth Punjab, Haryana and western Uttar Pradesh. The inoculation of nitrogen fixing Blue Green Algae (BGA) is an alternative and sustainable source of nitrogen to increase the rice productivity.

Cyanobacteria (Blue Green Algae) are one of the major components of the nitrogen fixing biomass in paddy field. The agricultural importance of cyanobacteria in rice cultivation is directly related with their ability to fix nitrogen and other positive effects plants and soil [1].

Blue Green Algae (cyanobacteria) are distributed worldwide and contribute to the fertility of many agricultural ecosystems, either as free-living organisms or in symbiotic association with the water fern azolla [2]. The nitrogen fixing ability of many species is the principal, but by no means the only, reason for this increased fertility. The particular importance of these organisms in rice culture was made clear in the review by Roger and Kulasooriya [3]. This includes many reports of the manipulation of rice field ecosystems to maximize blue green algal nitrogen fixation especially by the deliberate addition of dried inocula.

Algae are a large and diverse group of microorganisms that can carry out photosynthesis since they capture energy from sun light. Algae play an important role in agriculture where they are used as biofertilizer and soil stabilizers [4].

Nitrogen fixing blue green algae are known to be a prominent component of the microbial population in wetland soils, especially rice fields, contributing significantly to the fertility as a natural bio-fertilizer [5].

They are less expensive, ecofriendly and sustainable. The biofertilizer production cost is very low so is the selling price. On nutrient basis one tonne of fertilizer nitrogen (considering 20 kg of N fixed /ha) by application of 10 Kg of BGA [6].

Therefore, an attempt has been made through present trials to study the effect of different levels of nitrogen fertilizer along with blue green algae (BGA) over grain yield, nitrogen content and nitrate reductase activity in rice varieties Jaya and Sarju-52 grown in the region of Bareilly district.

2) MATERIALS AND METHODS

Field experiments were conducted at Nawabganj, agriculture Research Station at Bareilly. The experiment was performed in replicate, hence a block of land was divided in 30 plots of size 5x3 square metres along with inoculum comprising N fertilizer and as soil based BGA

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inoculum comprising a species of Aulosira, Anabaena, Nostoc, Tolypothrix, Calothrix and Westiellopsis were inoculated @ 12.5 Kg/ha over standing water in the field in basal form concurrently.

	Nitrogen level	+	BGA
C.	0 Kg/ha	+	0 Kg/ha
T_1	0 Kg/ha	+	12.5 Kg/ha
T_2	40 Kg/ha	+	12.5 Kg/ha
T_3	80 Kg/ha	+	12.5 Kg/ha
T_4	120 Kg/ha	+	12.5 Kg/ha
T_5	160 Kg/ha	+	12.5 Kg/ha

After 45 days of germination oven dried leaves were tested for the total nitrogen content by the micro-kzeldahl method [7]. Fresh leaves were tested for nitrate reductase activity by the method of Shrivastava, [8].
Grains at the time of maturity were collected plot wise and the sample of both the varieties were analysed for grain yield.

3) RESULTS AND DISCUSSION

Different levels of N fertilizer along with BGA had significant bearing on grain yield of rice in both the varieties.
Present observation clearly indicates a positive effect of N fertilizer along with BGA up to 80 KgN/ha on grain yield in both the varieties of rice. However, the values of all the treatments are significant.
Application of BGA inoculants in soil has been of much significance as they not only fix atmospheric nitrogen but also produce growth promotory and antifungal substances and ultimately increase the total yield per unit area.
The increase in growth and yield of rice has been reported earlier by many workers due application of blue green algae or nitrogen individually or in combination. Similar findings were also reported by – Kolte et. al. [9], Suri and Puri [10], Hegazy et. al. [11], Gopalaswamy et. al. [12].
Patel [13] also observed that grain yield of rice was increased when rice was soil inoculated with blue green algae along with 0 to 75 Kg N/ha as compared to no inoculation. Similarly, Sinha et. al. [14] found the application of 12.5 Kg N /ha BGA with 90 Kg N/ha gave favourable result with respect to grain and straw yield at recommended dose of 120 Kg N /ha. This is supported by Ojha et. al. [15].
Biofertilizers are good source of nutrient and can be used as supplement to chemical fertilizers, but not as a substitute. Use of microorganism like nitrogen fixer or blue green algae results in increased availability of nutrient.
Keeping in view the importance of nitrogen, their different combination with blue green algae was applied to the soil and their effect on total nitrogen have been recorded. A persual of the table will show that N fertilizer was given in increasing doses of nitrogen along with Blue green algae in last 4 treatments. Out of the six different treatments, a dose 80 Kg N /ha + BGA was found to give the highest nitrogen content 2.33% as compared to control 1.74 % value. Therefore, the observation recorded in table-2 suggested that the further addition of nitrogen is not at all necessary after 80Kg N/ha+ BGA level, because nitrogen content decreased to 2.31% at a level of 120 Kg N/ha+ BGA.

TABLE 1: Grain yield (q/ha) of Oryza sativa as affected by different levels of nitrogen fertilizer + BGA

Nitrogen level + BGA	Varieties		Total	Mean
	Jaya	Sarju-52		
C. 0 kg/ha	42.83	41.28	84.11	42.06
T1. 0 kg/ha + 12.5 kg	49.16	48.39	97.55	48.78
T2. 40 kg/ha + 12.5 kg	53.33	52.86	106.19	53.1
T3. 80 kg/ha + 12.5 kg	61.67	59.35	121.02	60.51
T4. 120 kg/ha + 12.5 kg	60.04	58.98	119.02	59.51
T5. 160 kg/ha + 12.5 kg	59.34	56.83	116.17	58.09
Total	326.37	317.69		
Mean	54.4	52.95		

CD at 5% (0.20)

Sundara et.al. [16] reported that due to algal inoculation that nitrogen content in the rice grain increased by 16 % Over Control. The percentage nitrogen content in the rice grain was also reported to be increased by Algal inoculation [17, 18, 19].

TABLE 2: Nitrogen Content (percentage on dry matter basis) in the leaves of *Oryza sativa* as affected by different leaves of nitrogen fertilizer + BGA

Nitrogen level + BGA	Varieties		Total	Mean
	jaya	sarju-52		
C. 0 kg/ha	1.75	1.72	3.47	1.74
T1. 0 kg/ha + 12.5 kg	1.78	1.75	3.53	1.77
T2. 40 kg/ha + 12.5 kg	1.89	1.86	3.75	1.88
T3. 80 kg/ha + 12.5 kg	2.54	2.11	4.65	2.33
T4. 120 kg/ha + 12.5 kg	2.52	2.09	4.61	2.31
T5. 160 kg/ha + 12.5 kg	2.25	2.08	4.33	2.17
Total	12.73	11.61		
Mean	2.12	1.94		

CD at 5% (0.02)

Assimilation of nitrate starts with its reduction to nitrite. This may take place either in root itself or in the leaves. The reduction of nitrate to nitrite is catalyzed by the enzyme nitrate reductase, which uses reducedpyridine nucleotides as electron donor coenzyme.

$$NO_3^- + 2e^- \xrightarrow[NaD(P)\ H^+]{\text{Nitrate reductase}} NO_2^- + H_2O$$

Data showed that plant grown with both N and blue green algae had higher NR activity compared to plant grown with N alone. From these data it can be inferred that for nitrate reductase activity inoculation of blue green algae is beneficial.

The value of NRA is 6.42, 6.60, 6.99, 7.53, 7.52 and 7.15 in vareity Jaya and 6.30, 6.44, 6.73, 7.40, 7.37, and 7.01 µ mol. NO_2/g/h in variety Sarju- 52 Over Control. But the highest value was found at level of 80 KgN/ha + 12.5 Kg BGA is beneficial for NRA content because the value of NRA decreases.

These findings are in conformity with the following authors. Mehta et.al. [20] investigated the influence of extracts of algal on oxidizing enzyme activity of rice seed and found an increased in catalase activity and peroxidase activity.

Kumari et.al. [21] observed increase NR activity in Indian mustard when putrescine was included in nutrient solution.

TABLE 3: Nitrate reductase activity (µ mol NO2 g-1 f.w.t. ha -1) in the leaves of Oryza sativa as affected by affected by different levels if nitrogen fertilizer + BGA

Nitrogen level + BGA	Varieties		Total	Mean
	Jaya	Sarju-52		
C. 0 kg/ha	6.42	6.3	12.72	6.36
T1. 0 kg/ha + 12.5 kg	6.6	673	13.04	6.52
T2. 40 kg/ha + 12.5 kg	6.99	6.73	13.72	6.86
T3. 80 kg/ha + 12.5 kg	7.53	7.4	14.93	7.47
T4. 120 kg/ha + 12.5 kg	7.52	7.37	14.89	7.47
T5. 160 kg/ha + 12.5 kg	7.15	7.01	14.16	7.08
Total	42.21	41.25		
Mean	7.04	6.88		

CD at 5% (0.69)

Among the two varieties yield and nutritional value was found better in Jaya then Sarju-52. The above experiment leads to the conclusion that rice inoculated with BGA, increased grain yield, nitrogen content and nitrate reductase activity and the best results are obtained when 80 Kg nitrogenous fertilizer combined with 12.5 Kg Blue green algae/ha is used as a net saving of 40 Kg nitrogenous fertilizer/ha can be achieved. So Blue green algae can be used as bio fertilizer to increase rice yield.

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