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Implication of Some BGA Biofertilizers on growth and yield of Oryza sativa L. (var. Shriram)

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ABSTRACT: BGA is considered to be one of the most important components of the nitrogen fixing biomass in paddy fields. The agricultural significance of BGA in rice cultivation is directly related with their nitrogen fixability and other optimistic effects for plants and soil. After water, nitrogen is the second limiting factor for plant growth in many fields and deficiency of these elements is met by fertilizers (Malik et al 2001) .An excessive use of chemical fertilizers has generated several environmental problems including the greenhouse effect, ozone layer depletion and acidification of water these problems can be tackled by use of biofertilizers (Choudhury and Kennedy 2005, Rai2006). BGA plays a potential role in crop protection as herbicides, algaecides, nematicides, fungicides and insecticides (Deviram et. al 2011). In present investigation attempts were made to inoculate the locally identified strains of cyanobacteria (BGA)as biofertilizers and to examine its effects along with chemical fertilizers (NPK) upon growth and yield of Oryza sativa L. (var. Shriram), Experiments determined that combined inoculation of BGA with chemical fertilizers (NPK) proved better results in almost all growth parameters and yield.

Keywords: BGA, Paddy, Cyanobacteria, Biofertilizers

I. INTRODUCTION

With the day to day rise in population in the developing countries including India, agriculture is undergoing immense stress continuously. Even with all the advancements, land area under farming is not increasing but progressively depleting which has caused an overall increased burden on agriculture. Therefore, the land available for agriculture should be economically managed so as to obtain maximum results from the utilized land. Most of our agriculturally available land is deprived in minerals necessary for proper plant growth and development. Repeated use of land for farming leads to progressive deprivation of fertility as a result of depletion of nutrients from the land. One such very essential plant nutrient is Nitrogen. It is an important element required for proper plant growth and development. It is supplemented in the form of chemical fertilizers which could pose a serious health hazard or can produce threatening levels of pollution in the soil and taking a toll on soil health. Apart from being expensive, it also highly increases production costs. This is the mainspring reason for higher recommendations towards using of biofertilizers instead of chemical fertilizers. Biofertilizers are living microbial formulations which fix the available atmospheric nitrogen while living symbiotically with the plants or free living in the soil.The use of bio fertilizers lead to improved nutrients and water uptake, plant growth and plant tolerance to abiotic and biotic factors (Itelima et. al 2018)

The paddy field proves to be a suitable ecosystem for cyanobacterial habitation with considering their requirements for light, water, high temperature and nutrient availability. This could be the reason for more abundant cyanobacteria growth in paddy soils than in upland soil (Roger and Reynaud 1982, Kondo and Yasuda 2003). The abundance of cyanobacteria in rice fields has been reported by number of researchers since Fritsch' accounts (Fritisch 1907 a,b). Culture studies were introduced by Bannerji (1935) and the importance of blue - green algal nitrogen fixation in helping to maintain fertility of rice fields was first recognized by De (1939). Thereafter, Watanabe and Konishi (1951), Venkataraman (1972) and Roger and Reynaud (1982) studied further on this basis.The inoculation of BGA is an alternative and sustainable source of nitrogen to increase the rice productivity (Paudel et. al 2012). Beneficial effects of cyanobacterial inoculation on rice were also reported by Subhashini et. al 2007, Khairnar and Thakur 2011,Thakare et. al 2011, Malakar et. al 2012, Satsangi and Yadav 2013, Sao and Samuel 2015, Singh et. al 2016, Sinha 2017, Mahto and

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Sahu 2017, Dahal and Bhandari 2018, Selviraj and Dinesh 2018, Ojha et. al 2018, Sravan and Singh 2019.

Rice (Oryza sativa L.) is one of the first leading ancient (3,000 BC) cultivated crops of the world. Now the food habit of global people is changing rapidly and cultivation of rice is also increasing tremendously through the world (Paudel et al 2012). Rice is one of the most produced and largely consumed food crops in Nagbhid Taluka. An abundance of cyanobacterial population is seen in rice fields of the area. Thus, this is an attempt to study the effects of BGA as biofertilizers observing the diversity of Cyanobacteria in Paddy ecosystems of Nagbhid Taluka. It is aimed at understanding the role of Cyanobacteria as Biofertilizers in rice fields.

II. MATERIALS AND METHODS

The experiments were conducted in pots during rainy season in year 2017-2018 and 2018-2019 using locally grown Shriram rice variety at Nagbhid tehsil district Chandrapur, Maharashtra, India. (Longitude 79°40'0" East and Latitude 20°35'0" North) The seeds of local shriram variety were sown in a seed bed measuring 1 m × 0.5 m at optimum soil moisture conditions in the month of July and 20 days young seedlings were transplanted in pots number 1-5. Five pots with one feet height were selected and used for rice seedling plantation. Cyanobacterial strains of Nostoc commune and Anabaena variablis Collected from the rice fields of Nagbhid tehsil and cultured in BG11 media. Mass culture of each biofertilizer was made in 1 lit of liquid medium by inoculating with 15 days old cultures. Pot no. 1 considered as control without any inoculation, pot no. 2 inoculated with 10 ml liquid biofertilizer of Nostoc commune and Pot no. 3 inoculated with 10 ml liquid biofertilizer of Anabaena variabilis , Pot no. 4 inoculated with 10 ml of combined both bioferilizers and pot no. 5 inoculated with 10 ml of both combined biofertilizers and small amount of chemical fertilizer (NPK). Biofertilizer added in different pots into 3 splits, Basal, tillering and panicle/ flower initiation.

Five treatments were made to find out effect of each biofertilizer on Oryza sativa L. (var. Shriram). The effects of individual treatment of each strain, combination of two strains and combined effect of both biofertilizers with chemical fertilizer on Oryza sativa were taken into account in the experimental study. Biometric observations were recorded during growth of plants and before the harvesting of plants.

1) Height of plants
2) Number of branches per plant (Tillers)
3) Number of Leaves
4) Length of root
5) Weight of fresh root
6) Weight of dry root
7) Number of panicles
8) Length of panicles
9) Number of spikes/panicle
10) Yield of grains

III. RESULTS AND DISCUSSION

Table-1 Effect of BGA with major chemical fertilizers NPK on yield parameters of Rice (Oryza sativa) for the year 2017- 2018

Treatments	T0	T1	T2	T3	T4
Plant height in cms	51	72	83	89	93
Length of root/plant in cms	4.2	6.3	7.2	8.5	9.3
Weight of fresh root/plant in gma	0.25	0.37	0.39	0.45	0.55
Weight of dry root/ plant in gms	0.03	0.06	0.08	0.10	0.12
Number of tillers/plant	2.0	4.0	5.0	4.0	5.0
Number of leaves/ plant	3	4	4	5	6
Number of panicles/ plant	8	8	8	9	12
Length of panicles in Cms	16	18	19	22	24
No of spikes/ panicle	203	210	256	277	288
Yields of grain/plant in gms	1.025	1.09	1.13	1.26	1.59

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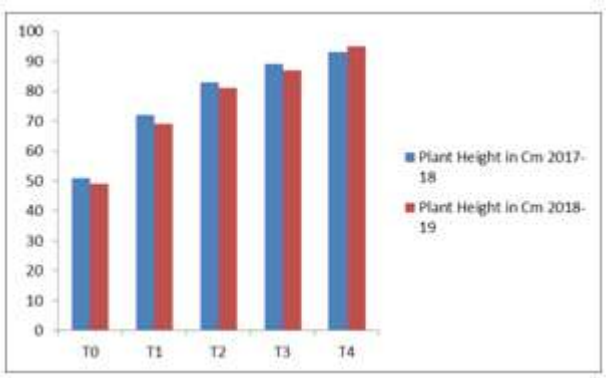
Table-2 Effect of BGA with major chemical fertilizers NPK on yield parameters of Rice (Oryza sativa) for the year 2018- 2019

Treatments	T0	T1	T2	T3	T4
Plant height in cms	49	69	81	87	95
Length of root/plant in cm	4.5	6.2	7.4	8.4	9.5
Weight of fresh root/plant in gms	0.28	0.38	0.38	0.46	0.53
Weight of dry root/ plant in grams	0.04	0.05	0.09	0.11	0.14
Number of tillers/plant	3.0	5.0	4.0	4.0	5.0
Number of leaves/ plant	4	5	4	6	5
Number of panicles/ plant	7	8	7	10	14
Length of panicles in Cms	18	21	21	24	26
No of spikes/ panicle	206	213	262	274	291
Yields of grain/plant in gms	1.032	1.07	1.12	1.29	1.56

1. Plant height

Plant height of Oryza sativa was very less in control condition and 51 and 49 a treatment with an average value where as Nostoc sp. treatment was 72 and 69cms, in Anabaena sp. treatment was 83 and 81cms, in combination of Nostoc and Anabaena inoculum was 89, 87cms.

The combined effect of two bio-fertilizer such as Nostoc sp. Anabaena sp. and major chemical fertilizers show more significant result in height of plant. The height of plant is observed 93 and 95 cm on average.



2. Length of root

An average length of root of Oryza sativa was short in control condition i.e. 4.2 and 4.5cms, in treatment, with Nostoc sp. 6.3and 6.2 cms, in Anabaena sp. 7.2 and 7.4cms. However in combination of Nostoc and Anabaena strain of inoculums was 8.5 and 8.4cms. The combined effect of two biofertilizers such as Nostoc sp. and Anabaenasp with major chemical fertilizers shows more significant result in length of plant observed 9.3 and 9.5cms.

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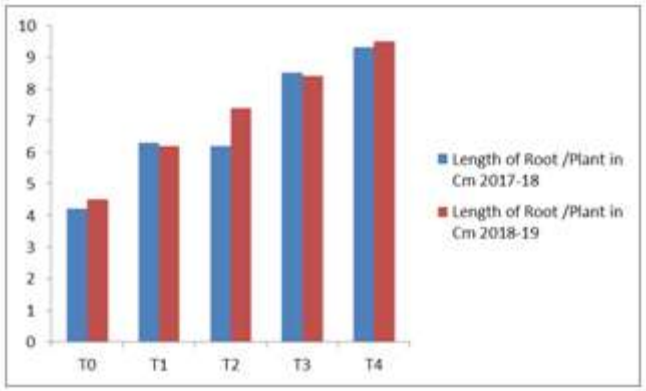
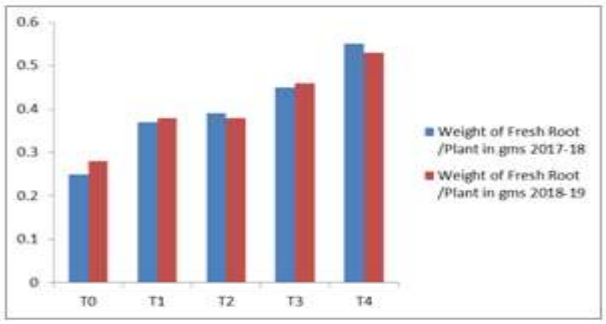


3. Weight of fresh roots

Average weight of fresh roots of Oryza sativa was 0.25 and 0.28gm in control condition and 0.37 and 0.38gm in treatment Nostoc sp., 0.39 and 0.38 gm in Anabaena sp. Treatment, 0.45 and 0.46 gm in combination of Nostoc and Anabaena. The combined effect of two biofertilizers Nostoc sp. and Anabaena sp. with major chemical fertilizers shows more significant result in root weight of plant observed 0.55 and 0.53 gm.

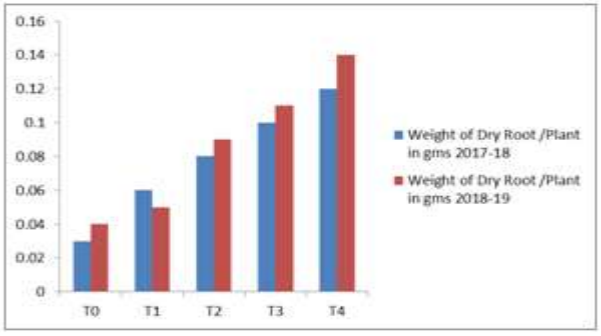
The combined effect of bio-fertilizers of Nostoc sp. and Anabaena sp. with chemical fertilizer NPK shows more significant result.



4. Weight of dry root

An average weight of dry root of Oryza sativa was 0.03 and 0.04 gm in control condition in treatment with Nostoc sp. was 0.06 and 0.05 gm., in Anabaena sp. treatment was 0.08 and 0.09 gm. While in combination of Nostoc and Anahaena it was 0.10 and 0.11 gm. The combined ufect of two biofertilizersNostoc sp. and Anabaena n with major chemical fertilizers shows more significant resuli in dry root weight of plant observed 0.12 and 0.14 gm.

The combine effect of bio-fertilizers of Nostoc sp. and Anabaena sp. with chemical fertilizers NPK shows more significant result.



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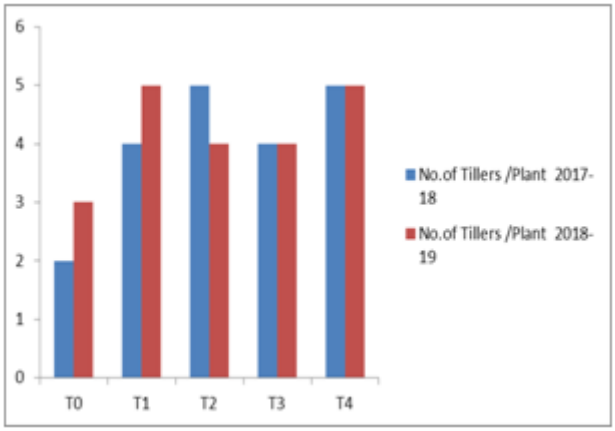
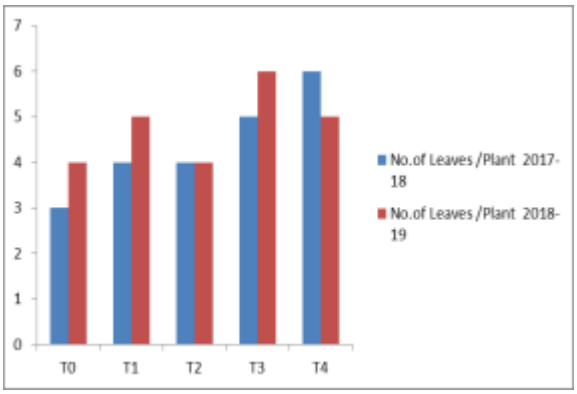
5. Number of tillers

Numbers of tillers of Oryza sativa were slightly less in control condition 2.0 and 3.0 tillers in an average, whereas individual Nostoc treatment was 4.0 and 5.0, In a treatment was 5.0 and 4.0. While in combination of two bio-fertilizer N and Anabaena treatment was 4.0 and 4.0.

The combined effect of Bio-fertilizer Nostoc, and Anabaena with chemical fertilizers NPK treatment was found more significant and number of tillers observed was 5.0 to 5.0 in an average.



6. Number of leaves



The number of leaves on an average basis of Oryza sativa was 3 and 4 per plant in control condition, in Nostoc sp. treatment 4 and 5 leaves per plant in Anabaena treatment 4 and 4 leaves per plant and in combination of Nostoc and anabaena sp. 5 and 6 leaves per plant. In combination of two bio-fertilizer Nostoc, and Anabaena the result is found 6 and 5 leaves per plant.

7. Number of panicles

The number of panicles of Oryza sativa was comparatively less in control condition 8 and 7panicles in an average whereas Nostoc sp. treatment was 8 and 8 panicles, in Anabaena treatment was 8 and 7panicles and in combination of Nostoc and Anabaena treatment was 09 and 10.

The combine effect of bio fertilizers Nostoc and Anabaena with chemical fertilizers NPK treatment shows more significant result and the number of panicles was observed 12 to 14 panicles in an average

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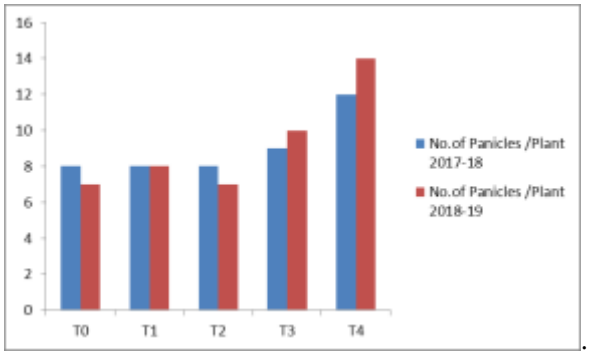
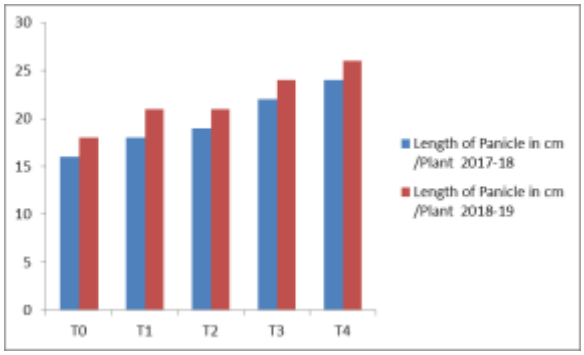


8. Length of panicle

The length of panicle of Oryza sativa was comparatively less in control condition 16 and 18 cm in an average whereas Nostoc sp. treatment was 18 and 21 Anabaena treatment was 19 and 21 cm and in combination of Nostoc and Anabaena treatment was 22 and 24.

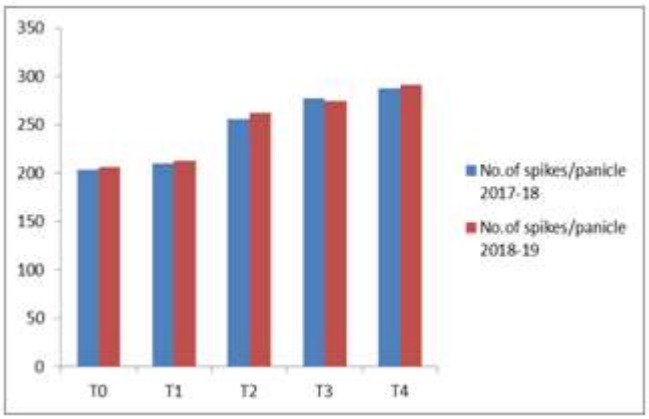
The combine effect of bio fertilizers Nostoc and Anabaena with chemical fertilizers NPK treatment shows more significant result and the length of panicle was observed 24 an 26 cm in an average.



9. Number of spiklets per panicle

The number of spiklets per panicle of Oryza sativa was comparatively less in control condition 203 and 206 in an average whereas Nostoc sp. treatment was 210 and 213 Anabaena treatment was 256 and 262 cm and in combination of Nostoc and Anabaena treatment was 277 and 274.

The combine effect of bio fertilizers Nostoc and Anabaena with chemical fertilizers NPK treatment shows more significant result and the number of spikes per panicle was observed 288 an 291 cm in an average.



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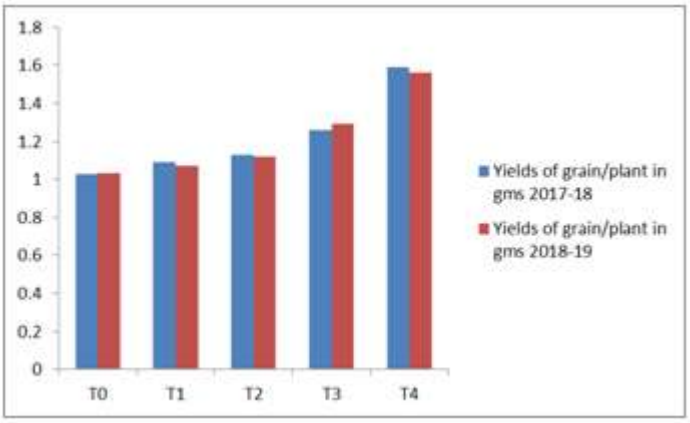
10. Yield of grain per plant



The grain yields per plant of Oryza sativa was comaparatively less in control condition and that was 1.025 and 1.032gms per plant on an average, were as in Nostoc sp. treatment was 1.09 and 1.07 and in Anabana sp. treatment was 1.13 and 1.12gms per plant in an average, Nostoc and Anabaena treatment was 1.26 and 1.29gms in an average.

The combined effect of bio-fertilizers Nostoc and Anabaena with chemical fertilizers NPK treatment was found more significant result. Grain yield per plant observed was 1.59 and 1.56 gms per plant in an average.

Application of bio-fertilizer including Nostoc, and Anabaena with chemical fertilizers NPK In order to enhance the soil fertility and increase per unit area per hectare crop production were studied thoroughly.

Orzyasativa L. (variety Shriram) was grown in soil with inoculation of bio-fertilizers alone and also combined with NPK chemical fertilizers. Oryza sativa showed more growth than control conditions when treated with biofertilizers, and best growth was observed when grown in combination of bio-fertilizer and chemical fertilizer treatment. In all treatments inoculated with BGA, Nostoc commune and Anabaena variabilis with low dose of NPK, there was a significant increase in all growth parameters like plant height, length of root, number of tillers, number of leaves, number of panicles, length of panicles, number of spiklets per panicle and grain yield over the control.

The above experiments have easily proved that the combination of BGA and conventional chemical fertilizers produce superior yields of crop in many parameters when compared to other formulations of BGA only or chemical fertilizers only.

IV. CONCLUSION

Treatments inoculated with BGA with a low dose of NPK fertilizer, there was a significant increase in all growth parameters like plant height, length of root, number of tillers, number of leaves, number of panicles, length of panicles, number of spiklets per panicle and grain yield over the control. Thus, poor farmers are to be encouraged to adopt a combination of BGA and some amount of chemical fertilizer (NPK) to obtain better rice output while reduction of total inputs as compared to usage of high amount of chemical fertilizers which are currently in use and produce harmful effects to the consumers, producers, as well as the environment.

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