

INDIAN JOURNAL OF AGRICULTURAL AND ALLIED RESEARCH

Agricultural Research • Soil Fertility • Sustainable Crop Production

VOLUME 1 | ISSUE 1 | ORIGINAL RESEARCH ARTICLE

Bio-fertilizer: Soil Fertility and Rice Production**Shah Alam*1, Rajendra Kumar Seth2, Bhashkar Dubey3 and D. N. Shukla4**

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ABSTRACT

The experiment has been done to assess soil fertility and increase the yield of rice production through Bio fertilizer. Azolla and Cyanobacteria (BGA) are one of the major components of the nitrogen fixing biomass in paddy fields. In this research, treatment with Azolla, T1 = control, T2 = 0.2 kg/m² + 100% P₂O₅ and K₂O, T3 = 0.2 kg/m² + 75 % P₂O₅ and K₂O, T4 = 0.2 kg/m² + 50% P₂O₅ and K₂O, T5 = 0.2 kg/m² + 25% P₂O₅ and K₂O. Treatment with cyanobacteria, T1 = control, T2 = 10 kg/ha + 100% P₂O₅ and K₂O, T3 = 10 kg/ha + 75 % P₂O₅ and K₂O, T4 = 10 kg/ha + 50 P₂O₅ and K₂O, T5 = 10 kg/ha + 25 P₂O₅ and K₂O. The 0.2 kg/m² Azolla + 50 P₂O₅ and K₂O and 10 kg/ha cyanobacteria + 50 P₂O₅ and K₂O inoculums found to be most effective treatment for the rice production and improve soil fertility. The treatment with azolla 0.2 kg/m² + 50 P₂O₅ and K₂O in inoculation of the treatment plot no. T4, in this treatment found that plant height was 103.15 cm, No. of tiller/hill 19, weight of 1000 grain was 22.98 gm, total yield 118.70% and increase yield 18.70% and 10 kg/ha cyanobacteria + 50 P₂O₅ and K₂O in inoculation of the treatment plot no. T4, in this treatment found that plant height was 102.97 cm, No. of tiller/hill 18, weight of 1000 grain was 22.70 gm, total yield 118.53% and increase yield 18.53% over all the other treatment plots. Biofertilizers is positively related to the production of Rice and maintenance and build up of soil fertility. Bio-fertilizers are eco-friendly and have been proved to be effective and economical alternate of chemical fertilizers.

Keywords: Bio fertilizer, Azolla, Cynobacteria, Rice, Yield and Soil fertility.

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's most important food crop as more than 40% of the world's population depends on rice as a major source of calories. In India, rice crop is cultivated in about 44.97 million hectares with an approximate total production on of 86.3 million tonnes.

Biofertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco friendly and can not at any cost replace chemical fertilizers that are indispensable for getting maximum crop yields. Microbiological fertilizers are important to environment friendly sustainable agricultural practices (Bloemberg et al., 2000). The Biofertilizer includes mainly the nitrogen fixing, phosphate solubilizing and plant growth promoting microorganisms (Goel et al., 1999). Biofertilizers have shown great potential as supplementary, renewable and environmental friendly sources of plant nutrients and are an important component of Integrated Nutrient Management (INM) and Integrated Plant Nutrition System (IPNS) (Raghuwanshi, 2012). Naturally grown biofertilizers not only give a better yield, but are also harmless to humans and lead to better sustainable economic development for the farmers and their country (Mishra and Dash, 2014).

Azolla is a fern of agronomic importance due to its ability to fix atmospheric nitrogen (Moore, A.W. 1969, Singh, P.K. 1977). Azolla in its leaf cavities helps in nitrogen fixation and in turn increases soil organic content in terms of total nitrogen after death of the Azolla plant. Watanabe et al, 1977, Reports are available to support its role as an animal feed, (Subudhi, B.P.R.; Singh, P.K. 1978) in hydrogen production, (Peters, G.A.; Toia, R.E.; Lough, S.M. 1977) and as a bio fertilizer.

Cyanobacteria or Blue green algae (BGA) are a group of microorganisms that can fix the atmospheric nitrogen. It play an important role in maintenance and build up of soil fertility, consequently increasing rice growth and yield as a natural biofertilizer (Song et al., 2005).

The aim of this research is pointing out the role of Azolla and Cyanobacteria as a biofertilizer in rice plants and improvement of soil fertility. The need for the use of biofertilizer has arisen, primarily for two reasons. First, because increase in the use of fertilizers leads to increased crop productivity, second, because increased usage of chemical fertilizer leads to damage in soil texture and raises other environmental problems. Therefore, the use of biofertilizer is both economical and environment friendly.

MATERIALS AND METHODS

The azolla and cynobacteria chosen for the experiments because biofertilizers are supposed to be safe alternative chemical fertilizers to minimize the ecological disturbance. Biofertilizers are cost effective, eco-friendly and when they are required in bulk, can be generated at the farm itself. Azolla fix nitrogen up to 40-60 kg N/ha and cynobacteria 25 kg N/ha. They improve soil texture, pH, and other properties of soil (Anonymous (2012b)).

INOCULATION OF BIO-FERTILIZER IN PADDY CROP

The experiment was conducted in the Department of Botany, University of Allahabad, UP, India during the 22 June to 15 October 2016. The trial was laid out RBD using three replication having until plot size 4.10×2.5 m², 20 cm row to row space and 15 cm plant to plant distance .

The treatment with Azolla ;

- T1 = control.
- T2 = 0.2 kg/m² + 100% P₂O₅ and K₂O
- T3 = 0.2 kg/m² + 75 % P₂O₅ and K₂O
- T4 = 0.2 kg/m² + 50 P₂O₅ and K₂O.
- T5 = 0.2 kg/m² + 25 P₂O₅ and K₂O.

The treatment with Cynobacteria;

- T1 = control.
- T2 = 10 kg/ha + 100% P₂O₅ and K₂O
- T3 = 10 kg/ha + 75 % P₂O₅ and K₂O
- T4 = 10 kg/ha + 50 P₂O₅ and K₂O.
- T5 = 10 kg/ha + 25 P₂O₅ and K₂O

Thirty day old seedling of Sarjoo-52 variety were transplanted in the experiment plot and filled with water up to 4-6 cm depth and Azolla was inoculated at 7 DAT. Cynobacteria broadcasting 10 kg soil based culture/ha. 5-7 days after transplanting of rice seedling with maintain sufficient water 5-10 cm for 15 days. Plant height grain yield and increase yield were recorded plot wise.

RESULTS

In the current study, the result was obtained plant height 103.15 cm, No. of tiller/ hill 19, weight of 1000 grain was 22.98 gm, total yield 118.70% and increase yield 18.70% from the treatment with Azolla 0.2 kg/m²+50% P₂O₅ and K₂O (Table: 1).

Table 1: Effect of different treatment with Azolla:

Treatment	Plant Height (cm)	No. of Tiller/hill	Wt. of 1000 Grain (gm)	Yield (%)	Increase Yield (%)
T1	95.15	14	19.36	100.00	00.00
T2	96.45	16	20.95	108.21	8.21
T3	98.35	17	21.85	112.86	12.86
T4	103.15	19	22.98	118.70	18.70
T5	97.58	18	21.90	113.12	13.12

The results were obtained plant height 102.97 cm, No. of tiller/ hill 18, weight of 1000 grain was 22.70 gm, total yield 118.53% and increase yield 18.53% from the treatment with Cynobacteria 10 kg/ha +50% P₂O₅ and K₂O (Table: 2).

Table 2: Effect of different treatment with Cynobacteria:

Treatment	Plant Height (cm)	No. of Tiller/hill	Wt. of 1000 Grain (gm)	Yield (%)	Increase Yield (%)
T1	94.76	13	19.15	100.00	00.00
T2	96.00	16	20.69	108.04	8.04
T3	97.86	16	21.47	112.11	12.11
T4	102.97	18	22.70	118.53	18.53
T5	98.15	17	21.43	111.90	11.90

DISCUSSION

The biofertilizers play an important role in improving the fertility of the soil (Kachroo and Razdan, 2006; Son et al., 2007). On the basis of result examined treatment with azolla in control condition it was found that plant height was 95.15 cm, No. of tiller/hill 14, weight of 1000 grain was 19.36 gm, total yield 100%. After field treatment with 0.2 kg/m² azolla+ 100% P₂O₅ and K₂O, plant height was 96.45 cm, No. of tiller/hill 16, weight of 1000 grain was 20.95 gm, total yield 108.21% and increase yield 8.21%. After field treatment with 0.2 kg/m² azolla+ 75% P₂O₅ and K₂O, plant height was 98.35 cm, No. of tiller/hill 17, weight of 1000 grain was 21.85 gm, total yield 112.86% and increase yield 12.86%. Field treatment with 0.2 kg/m² azolla+ 50% P₂O₅ and K₂O, plant height was 103.15 cm, No. of tiller/hill 19, weight of 1000 grain was 22.98 gm, total yield 118.70% and increase yield 18.70%. Field treatment with 0.2 kg/m² azolla+ 25% P₂O₅ and K₂O, plant height was 97.58 cm, No. of tiller/hill 18, weight of 1000 grain was 21.90 gm, total yield 113.12% and increase yield 13.12%. The nitrogen fixing capacity of Azolla has been estimated to be 1.1 kg N/ha/day and this fixed nitrogen is sufficient to meet the entire nitrogen requirement of rice crop within a few weeks (Lumpkin T. A. Plucknett D. L. 1980). Azolla is of great agronomic value for rice crop where it is used as dual crop with rice and contributes 40-60 kg N/ha per rice crop. Azolla forms an economical and eco friendly bio fertilizer which provides unseen benefits in terms of carbon and nitrogen enrichment of soil and overall improvement in soil/crop management practices and fertility status (Kaushik, B. D. Prasanna R. 1989). Improve soil fertility through Azolla. C. Van Hove, 1989, found that Azolla improves soil structure. Kotpal R. L. Bali N. P. 2003, stated that after its decomposition, humus is formed which increases the water holding capacity of the soil and promotes aeration and drainage.

On the basis of result examined treatment with cynobacteria in control condition it was found that plant height was 95.15 cm, No. of tiller/hill 14, weight of 1000 grain was 19.36 gm, total yield 100%. After field treatment with 10 kg/ha + 100% P₂O₅ and K₂O, plant height was 96.00 cm, No. of tiller/hill 16, weight of 1000 grain was 20.69 gm, total yield 108.04% and increase yield 8.04%. Field treatment with 10 kg/ha + 75% P₂O₅ and K₂O, plant height was 97.86 cm, No. of tiller/hill 16, weight of 1000 grain was 21.47 gm, total yield 112.11% and increase yield 12.11%. Field treatment with 10 kg/ha + 50% P₂O₅ and K₂O, plant height was 102.97 cm, No. of tiller/hill 18, weight of 1000 grain was 22.70 gm, total yield 118.53% and increase yield 18.53%. Field treatment with 10 kg/ha + 25% P₂O₅ and K₂O, plant height was 98.15 cm, No. of tiller/hill 17, weight of 1000 grain was 21.43 gm, total yield 111.90% and increase yield 11.90%. Blue green algae are reported to contribute to the higher nitrogen fertility of rice fields. They grow on the surface of paddy soil and water enriching with good source of nitrogen (Alexander, M. 1975, Baral et al; 1988). Prasad et al; 2003 reported yield increased by 5 to 24.1% in rice field by BGA inoculation. Gurung, S. 2004, reported 5.26% increase in soil N due to BGA inoculation in rice field of Kathmandu which ultimately increased the yield of rice. Mishra, U. and Pabbi, S. 2004, also found the yield increased by 12.3 to 19.5% on BGA inoculation in rice field.

CONCLUSION

Bio fertilizer application in rice field is better response of rice yield production and soil property, soil fertility status is maintain by azolla 0.2 kg/m²+50% P₂O₅ and K₂O and cynobacteria 10 kg/ ha with 50% P₂O₅ and K₂O. Application of Azolla and cynobacteria has been found to improve the significant for soil Nitrogen and Organic matter which directly help for improving the soil fertility. Azolla and cynobacteria is of great agronomic value for rice crop.

ACKNOWLEDGEMENTS

We are thankful to my sincerely Supervisor Prof. D.N. Shukla Department of Botany, University of Allahabad, Allahabad, India for Providing Laboratory Facilities and I also thanks to my friend Rajendra Kumar Seth for views and opinions expressed in this article.

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