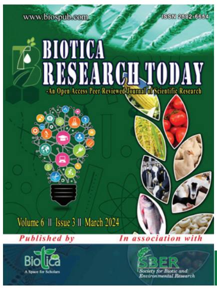

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Production Technology of Blue Green Algae

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Abstract

Blue-green algae (BGA) is a prokaryotic phototrophic organism capable of fixing nitrogen in the atmosphere and commonly used in agricultural fields for fertilizer, particularly in paddy fields. In addition to their ability to fix nitrogen, they are used with a variety of adsorbents to preserve soil fertility and other productivity-boosting soil components while also promoting crop growth. The current study demonstrated the various technologies used in the production of blue-green algae, its application and the impact of BGA on the growth and yield of paddy crops. Plants treated with inorganic fertilizers (N, P, K) produced lower yields and lowered growth attributes compared to the treatment (T_4) combined with NPK+BGA. Under these circumstances, the grain and straw yield increased by 22.2% and 28.9%, respectively, compared to the control (T_1).

Keywords: BGA, Environment, Inorganic fertilizers, Nitrogen

Introduction

Blue-green algae are a special group of aquatic plants. It is a cellular bacterium and is shaped like algae, so it is also called blue-green algae. It is also called cyanobacteria. This bacterium injects atmospheric nitrogen into the soil for paddy crops. It captures energy from photosynthesis and stabilizes atmospheric nitrogen in the land. It is an independently living bacterium, which does not have to depend on the paddy plant for energy like pulses crops. Since the paddy field is always full of water, favorable conditions exist for the growth and development of blue-green algae. A specialized cell in blue-green algae is responsible for nitrogen fixation and it stabilizes 20 to 40 kg of nitrogen hectare^{-1}. It increases the production of the crop and it improves acidic and alkaline land. A review of the biodiversity of algae in diverse habitats, contemporary applications and novel advancements that are broadening the avenues for economic exploitation was published by Thajuddin and Subramanian (2005). A significant amount of organic matter is added by carbon fixation by some sheathing BGA that live in the upper layers of dry soils (Singh *et al.*, 2016). Anaerobic circumstances allow BGA to fix nitrogen in heterocysts, specialized cells comprising 5-10% of the cells in a filament (Paudel *et al.*, 2012). The two most distinctive characteristics of cyanobacteria are their ability to adapt to the rice habitat and the formation of an independent system to supply the energy required for photosynthesis-based N_2 fixation (Das *et al.*, 2015). Blue-green algae partially supply nitrogen to the paddy crop by compounding atmospheric nitrogen. It supplies nitrogen to the paddy crop and helps maintain its quality and fertility by composting the residue of blue-green algae in that paddy field. The species of blue-green algae are Nostac, Ananabina, Calothrix, Cytoma, Tolipothrix, *etc*.

Medium Responsible for BGA Production

A 100 ml flask containing 5 g of topsoil from a paddy field is filled with Fogg's medium. After giving the flask a good shake, room-temperature incubation is performed. The culture is currently illuminated at 1500 lux to promote algal development. Now, using a loop to hold it in place, the algal culture is moved to 10 ml of water within a tube. To separate the algae filaments, the tube must be vigorously shaken. To initiate algal development, each dilution drop is put into

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Fogg's medium. In a Petri dish, this procedure is carried out.

Fogg's Medium

KH_2PO_2 - 0.2 g; $MgSO_4 \cdot 7H_2O$ - 0.2 g; $CaCl_2$ - 0.1 g; Na_2MoO_4 - 0.1 mg; $MgCl_2$ - 0.1 mg; H_3BO_3 - 0.1 mg; $CuSO_4$ - 0.1 mg; $ZnSO_4$ - 0.1 mg; Fe-EDTA - 1.0 ml; Distilled water - 100 ml; pH - 7. A drop is inspected under a microscope from each colony. It is only utilized going forward if it is intended to be a pure culture for a single species. When there are multiple species present, the sample gets diluted until a pure culture is isolated. The pure BGA cultures are put into culture flasks with Fogg's growth media inside of them. A suitable amount of light is provided to promote growth. Currently, starting cultures made of algae are employed. This has kickstarts the BGA mainstream culture. There are three methods to process it:

Trough Method

It is common to use zinc and iron troughs in the laboratory. A size of 2×3 cm and a height of 22 cm can be found on these. A trough containing 10-12 kg of soil is filled with 200 g of superphosphate. In this case, water is poured up to a height of 5-15 cm. The pH is adjusted to around 7 by adding calcium carbonate. There is a supply of sawdust to the soil. It is now covered with a sprinkling of starting culture. It is now covered with a sprinkling of starting culture. Pure cultures of BGA are transferred for growth to greenhouses and concrete tanks with fog medium (Figure 1). It receives watering every. When the BGA grows nicely and there is an adequate reaction, the soil is allowed to dry. For legalization, these arid flakes are gathered and packaged.

Figure 1: Performance of BGA in the greenhouse and in concrete tanks

Pit Method

Shallow pits are kept in direct sunlight. Polythene sheets are laid inside the pit to prevent percolation. A 20 cm pit is filled with soil, and it is watered to a height of 10 cm. Carbofuran is added to the pit once the pH is kept stable. The starting culture is then sprinkled on top of the sawdust-covered soil. Watering the pits encourages BGA growth. It is then let to dry on the soil.

Field Method

Small, 40-square-meter plots are kept in an open area. After applying 20 kg of superphosphate, the plot gets watered to a height of 15 cm. Following pH correction, 240 g of carbofuran is applied to the field. The plot is now given a beginning culture (5 kg), which is regularly irrigated. After BGA has developed for three to four weeks, the soil is allowed to dry. This technique allows for the harvesting of 30 kg of BGA inoculant. BGA is packed after it has been well-dried. The bags are kept in a dry, cool location.

Rural Techniques of Production of Blue-Green Algae Culture

- In any open space away from the shade, where the source of water is nearby, prepare a pit 5 to 10 m away from your needs, 1 to 1.5 m wide and about 15 cm deep. Place the soil extracted from that pit on the sail around the pit, so that the depth of the pit is about 5 cm and grow. Leave about 60 cm of space between two pits of this type, so that commuting is facilitated for observation and other work.
- Keep filling water in this pit for 2-3 consecutive days. There will come a time when the leakage of water will decrease. In such a situation, fill the pit with water and check it. This will close the small pores of the leaking soil.
- In such a situation, in the empty pit, measure the entire pit at the rate of 100 g m^{-2} and sprinkle super phosphate or rock phosphate and mix it in the soil by hand. If there is a place with black soil, then add lime at the rate of about 25 g m^{-2}.
- After this, filled the sand pit with 15 cm of water.
- Sprinkle 250 g of blue-green algae in the culture pit. Along with this, 1 ml of malathion or carbofuran should be added at the rate of 3 g m^{-2} to destroy the pests arising in this season.
- The pit treated with blue-green algae should never dry up. In case of a lack of water, fill it with water in the morning or evening and maintain the water level for 10-15 cm.
- If seen carefully, the color of its surface starts changing within 3-4 days on this pit. Blue-green algae begin to form as a thin fold. Gradually, in 10-15 days, this culture starts emerging in the form of thick folds.
- This thick it emerges in the entire surface of the ground or some part of it floats on the water during the summer days. Collect this floating culture, in which the soil content is negligible. It can be used as a re-pollinating culture.
- This culture produced in the pit can be extracted in two ways. Let this pit dry completely for two days and collect the dry crust there and keep it in clean bags. In the second type, in the wet state, remove the thick bottom from the large jar and dry it completely and collect it. This dry culture is blue green algae biofertilizer.

Application Techniques for BGA Biofertilizer

- In a rice-growing area, one package (500 g) of ready-to-use Multani mitti-based BGA biofertilizer is combined with four kilograms of dried and sieved farm soil.
- The above BGA biofertilizer is broadcasted to standing water in the rice field 3 to 6 days after transplanting rice seedlings.
- After the inoculation, the field needs to remain wet for ten to twelve days to promote healthy BGA growth.

Treatment of Blue-Green Algae in Paddy Field

Within 6 to 10 days of planting paddy plants in a paddy seed or transplanted field, 10 kg of blue-green algae can be planted. The dried powder is treated by spraying it all over the field. Before being treated with blue-green algae, the field should be about 8 to 10 cm long. Keep the water and keep it in the field for 20 days. After some time, we see that the thick BGA mat starts appearing clearly in the paddy field and the growth and propagation of blue-green algae is done properly (Figure 2).

Figure 2: Thick mat of BGA produced in a Paddy field

Effect of BGA on Yield Parameters of Rice (*Oryza sativa* variety Shabhagi)

NPK with BGA treatment can achieve comparable or even higher yields of paddy than only NPK or BGA. The four treatments that were applied are given in table 1. The superior grain yield of NPK with BGA treatment in comparison to other treatments, can be attributed primarily to factors such as an increased number of grains panicles^{-1} and higher thousand-grain weight. The plant height and number of grains panicles^{-1} were significantly higher (T_4) than the other treatments. In the treatment (T_4), the maximum value of grain and straw yield was recorded with the combined application of NPK with BGA (Table 2). Under these circumstances, the grain yield increased by 22.2% and the straw yield increased by 28.9% as compared to the control (T_1).

Table 1: Mode of Treatments: BGA, NPK and BGA with NPK

Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	BGA (10 kg ha^{-1})	Method of Application
T_1	0	0	0	-	-
T_2	0	0	0	+	Inoculation during transplantation
T_3	100	40	40	-	N used in three splits
T_4	40	30	20	+	N used in three splits

Benefits of using Blue-Green Algae

Nitrogen Fixation

Blue-green algae can fix atmospheric nitrogen and change it into a form that is available for plants. As a symbiotic relationship develops between them and rice plants, nitrogen is enhanced in the soil, leading to increased productivity. This reduces the reliance on synthetic nitrogen fertilizers, which can be costly and environmentally damaging.

Increased Crop Yield

The nitrogen fixation ability of blue-green algae can contribute to improved rice crop yields. The additional nitrogen supply promotes vigorous growth, enhances chlorophyll production and increases the overall photosynthetic efficiency of plants. As a result, the plants may produce more tillers, larger panicles and heavier grains, leading to higher yields.

Improved Soil Health

Blue-green algae can play a crucial role in improving soil health and fertility. By fixing nitrogen and enhancing nutrient availability, they enrich the soil and provide essential elements for plant growth. The presence of blue-green algae also helps in improving soil structure and moisture retention, reducing erosion and preventing nutrient leaching.

Environmental Sustainability

Blue-green algae offer an eco-friendly and sustainable approach to agriculture. Their ability to fix nitrogen reduces the need for synthetic fertilizers, which can have detrimental effects on water bodies due to runoff. By using blue-green algae, farmers can reduce the environmental impact of rice cultivation, including the pollution of waterways caused by excess nitrogen.

Future Prospects of BGA Fertilizer

Chemical fertilizers are used more often nowadays for agricultural production, which has an impact on the condition of the soil and environment and the sustainability of the agricultural crop production systems. To manage agricultural productivity and safeguard the environment at the same time, BGA should be used appropriately. This helps to maintain the quality of the soil. Modern technology combined with traditional conservation-based farming techniques can lower farming expenses and environmental risks while also reducing farmers' reliance on chemical pesticides and fertilizers.

Table 2: Effect of BGA on yield parameters of rice (*Oryza sativa*)

Treatments	Plant height at the harvesting stage (cm)	No. of grains panicles^{-1}	Wt. of 1000 grains	Grain yield (t ha^{-1})	% increase	Straw yield (t ha^{-1})	% increase
T_1	120	55	20	4.5	100	7.6	100
T_2	138	68	21	4.9	108.8	9.4	123.6
T_3	142	70	22	5.2	115.5	9.5	125
T_4	148	75	24	5.5	122.2	9.8	128.9

Conclusion

For various academic and practical reasons, studying BGA has been "fashionable" over the past 20 years. The importance that nitrogen-fixing BGA plays in maintaining rice fields' fertility has been amply demonstrated and recorded. To encourage rice plant development and yield production, blue-green algae work better when combined with chemical fertilisers. The highest yield was obtained from T_4 (NPK+BGA). The experiment suggests that, as compared to plants grown with chemical fertilizer, plants grown with NPK+BGA generally produced greater growth rates and yield. This experiment has indicated that using low-cost effective as well improved soil fertility and resulted in higher growth of the plant and yield.

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