



Effect of selective blue green algal species on the seedling growth of Paddy crop

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Abstract

Nitrogen is the most common limiting nutrient needed to increase agricultural production in cropping systems. This issue was rectified by blue green algae which could be applied as a biofertilizers in paddy fields. They are commonly called as cyanobacteria and are microbial biofertilizer applied in agriculture for enhancing the growth of cereal crops. It can fix the atmospheric nitrogen and converts into ammonium compounds. These compounds were further utilized by plants through root system. The use of cyanobacteria as a potential bio-fertilizer in rice fields as well as their beneficial roles in promoting crop growth and productivity. In the present investigation cyanobacterial species: *Phormidium* and *Merismopedia* were isolated and mass cultured and were used as inoculums in poly bag culture experiment which dealt with the effect of isolated blue green algae on the seedling growth efficiency of paddy crop. The growth parameters such as fresh weight, dry weight, number of leaves, shoot and root length, chlorophyll contents of blue green algae inoculated paddy plants was measured at 5th and 20th day period. The results showed that the significant growth was observed in paddy seedlings under cyanobacteria inoculated when compared to control plant. The present work suggested that the soil application of blue green algae which enhanced the seedling growth along with improve soil fertility in agriculture field without supply of other nitrogen fertilizers.

Keywords: Biofertilizer, paddy field, nitrogen fixation, soil fertility, blue green algae

Introduction

Paddy is one of the most important cereal crops in Asia which is grown in 44.3% of India's land. 141 million metric tons of grains are produced annually on a million hectares. Agriculture is critical factor for our country's

growth and survival with the healthy soil which is the lifeblood of agriculture. The cyanobacteria can fix atmospheric nitrogen which showed beneficial effects on plants along with soil fertility management in agricultural production. It is maintaining soil quality with efficient key factor for long-term food

production. Various scientific innovations on Agriculture worked out by researchers over the years to make it more efficient (Ajmal *et al.*, 2018).

Cyanobacteria act as a potential fertilizer for their application which lead to develop environment-friendly and sustainable agricultural practices (Singh *et al.*, (2016&2017). They are naturally occurring beneficial organisms which have an ecological importance and they provide nutrients to plants along with maintaining soil structure and fertility. Such bio-inoculation of the algae could increase crop production.

Biological Nitrogen fixation (BNF) technology has been the potential route to replace commercially available chemical fertilizer in paddy production, thereby alleviating some of these environmental issues (Prasanna, 2009). They are a cost-effective and environmentally friendly which is alternative to chemical fertilizers for achieving the target goal of increased productivity, particularly in paddy cultivation (Shweta *et al.*., 2018). The present study was initiated to study the effect of selective blue green algae which was isolated from the paddy field soil on the seedling growth of Paddy crop under laboratory condition.

Materials and Methods

Soil samples were collected from selective paddy fields of T. Athikarai and Sivagangai districts. They were treated to remove inert materials and stored in polythene bags. One gram of soil was transferred to 9 ml sterilized distilled water in a test tube and thoroughly mixed and 1 ml of diluted sample was transferred into another tube containing 9 ml sterilized water and it was repeated up to a 10^{-9} dilution. For adequate growth of cultures, 1 ml each of 10^{-5} , 10^{-6} , and 10^{-7} and 10^{-8} diluted samples were inoculated into BG¹¹ Medium and incubated for 60 days at room temperature under continuous illumination at 16 and 18 hours light and dark cycles with 2500 – 3000 light intensity provided by white lamp.

The algal growth in media were observed after massive growth of cyanobacteria in medium. It was viewed and identified under a binocular research microscope. Algal growth was measured at regular interval of 15 days.

Isolated blue green algae were sub-cultured and mass cultured under laboratory flask culture method. Then it was used as a bio-inoculum for the polybag culture study with Paddy plant. The bag culture technique was assigned with the following treatments: Control (without Blue green algae), T1 (*Phormidium* inoculated), T2 (*Merismopedia* inoculated) and T3 (*Phormidium*+*Merismopedia*). After soil inoculation with selective blue green algae in poly bags, the water soaked seeds were transferred to each assigned bags in same order. Regular watering was followed and the growth of paddy plant was measured at 5th and 20th day of growth period with the following parameters such as: Shoot length, root length, fresh weight, dry weight and number of leaves.

Results and Discussion

Blue green algae (BGA) are procaryotic organisms which can easily fix atmospheric nitrogen due to the presence of specialized cells called heterocyst (large, thick-walled, metabolically active cells. Such microscopic algae are found in both freshwater and marine ecosystems. These are used as a biofertilizers in paddy and bean cultivation. It involved in the decomposition of organic matter and also improved soil structure and fertility (Chittora *et al.*, 2020).

In the present investigation, the *Phormidium* and *Merismopedia* was isolated from the T. Athikarai and Sivagangai districts of Tamil Nadu. These organisms were sub cultured and pure cultured continuously without facing any contamination during COVID19 situation. Both organisms were treated with paddy plant (seedling stage) under laboratory condition at single and dual inoculation. Such results were observed and measured at 5th and 20th day

period for the morphological growth parameters namely fresh weight, dry weight, shoot length, root length and number of leaves (Table: 1, Plate: 1 and Fig: 1). The fresh and dry weight of dual inoculated paddy plant showed maximum as 0.46 ± 0.002 gm and 0.07 ± 0.000 gm

at 20th Day when compared to other single inoculated (T1: 0.387 ± 0.002 gm; 0.07 ± 0.001 gm; and T2: 0.51 ± 0.00 gm; 0.107 ± 0.002 gm) and control plants (0.40 ± 0.00 gm and 0.24 ± 0.003 gm).

Table: 1 Effect of selective blue green algae on the seedling growth of Paddy

Growth parameters	C 5 th Day	C 20 th Day	T1 5 th Day	T1 20 th Day	T2 5 th Day	T2	T3 5 th Day	T3 20 th Day
Fresh weight (gm)	0.133 ± 0.001	0.40 ± 0.00	0.133 ± 0.002	0.387 ± 0.002	0.133 ± 0.001	0.51 ± 0.00	0.20 ± 0.001	0.46 ± 0.002
Dry weight(gm)	0.01 ± 0.001	0.24 ± 0.003	0.003 ± 0.002	0.07 ± 0.001	0.003 ± 0.000	0.107 ± 0.002	0.067 ± 0.001	0.07 ± 0.000
Shoot length(cm)	7.17 ± 1.03	27.2 ± 1.50	7.2 ± 0.05	29.07 ± 1.03	7 ± 0.04	27 ± 1.50	7.6 ± 0.04	29.57 ± 1.1
Root length (cm)	3.2 ± 0.2	3.73 ± 0.01	2.57 ± 0.05	5.17 ± 0.02	2.47 ± 0.02	4.7 ± 0.00	2.57 ± 0.02	4.87 ± 0.03
Chlorophyll a (μ g/ml)	1.000 ± 0.002	1.097 ± 0.001	0.473 ± 0.021	1.843 ± 0.003	1.590 ± 0.010	3.727 ± 0.023	2.017 ± 0.020	3.640 ± 0.202
Chlorophyll b (μ g/ml)	0.147 ± 0.001	0.230 ± 0.002	0.273 ± 0.010	1.360 ± 0.000	0.300 ± 0.022	0.363 ± 0.012	0.797 ± 0.024	0.263 ± 0.020
Total chlorophyll (μ g/ml)	3.180 ± 0.010	4.647 ± 0.020	5.043 ± 0.013	9.477 ± 0.000	3.947 ± 0.002	7.363 ± 0.001	5.137 ± 0.010	10.547 ± 0.022

Values are mean of three replicates $\pm$ SD

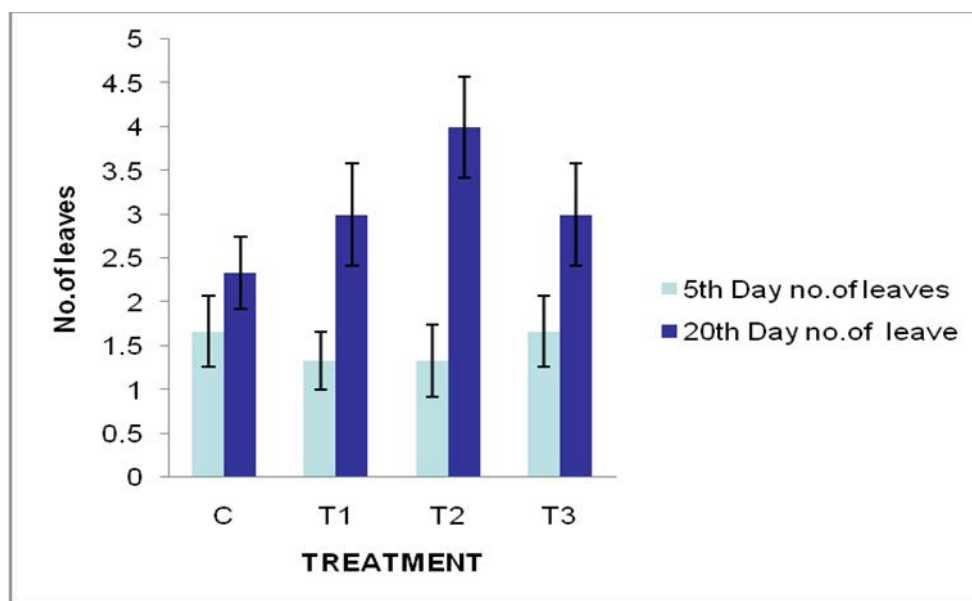


Fig: 1 Effect of selective blue green algae on the leaf production in Paddy seedlings
C-control T1- *Phormidium*, T2- *Merismopedia* T3- *Phormidium+Merismopedia*

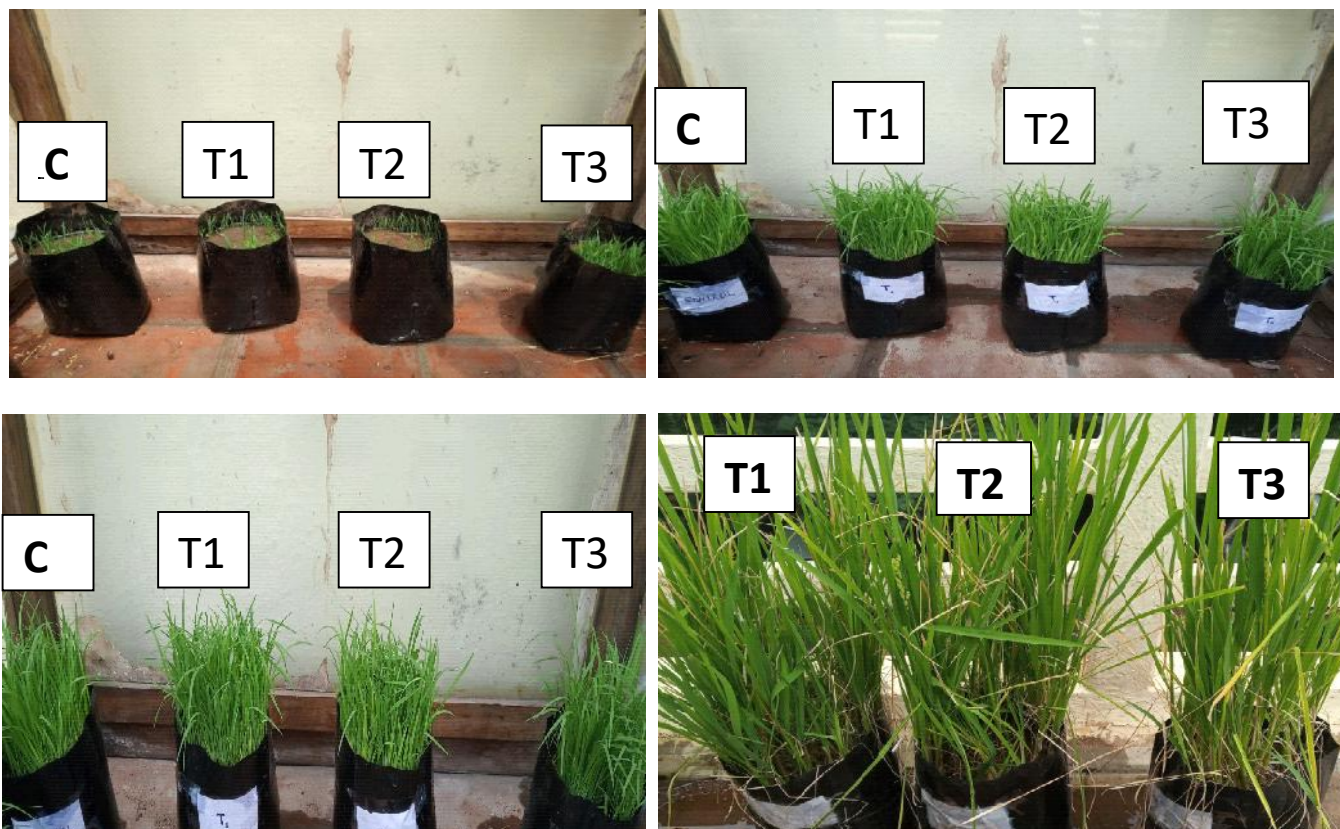


Plate:1 Effect of selective blue green algae on the seedling stage of Paddy

C-control T1- *Phormidium*, T2- *Merismopedia* T3- *Phormidium*+*Merismopedia*

The shoot and root length were gradually increased from 5th Day to 20th day period of growth in all plants. It was observed maximum in T1 (29.07 ± 1.03 ; 5.17 ± 0.02 cm) and T3 (29.57 ± 1.1 ; 4.87 ± 0.03 cm) plant when compared to T2 (27 ± 1.50 ; 4.7 ± 0.00 cm) and Control plant (27.2 ± 1.50 ; 3.73 ± 0.01 cm). The number of leaf production and the quantity of photosynthetic pigments was higher in T1, T2 and T3 plants (dual blue green algae inoculated) and it was lower in control plants (Fig: 1 and 2). This indicated that the both single and dual inoculation of *Phormidium* and *Merimopedia* enhanced the photosynthetic activity in Paddy when compare to control plants. This indicated that the blue green algae played a key role in the plant growth and photosynthetic activity by means of biological nitrogen fixation and mobilization in such crops.

The cyanobacterial biodiversity was measured from different freshwater ponds in and around Karimnagar, Telangana state (India) during the summer (Venumadha *et al.*, 2015). According to Tamil Kumar and Sayed (2018) the cyanobacterial isolates could be utilized for both biodegradation and biotransformation process of Lamdacyhalothrin pesticides. Two cyanobacterial strains, *Calothrix* sp. and *Microchaete* sp., were isolated from rice fields in Karimganj district, South Assam, India, and characterized using morphological, biochemical, and molecular methods (Moirangthem *et al.*, 2016). Such pure cultures of algae were used to extend the biomass of particular species which could be used as biofertilizers. In the blue green algae formulation study (Bagampriyal and Sadhana, 2020) the isolated cyanobacteria from paddy fields of southern districts with different adsorbents soils which could enhanced the paddy growth.

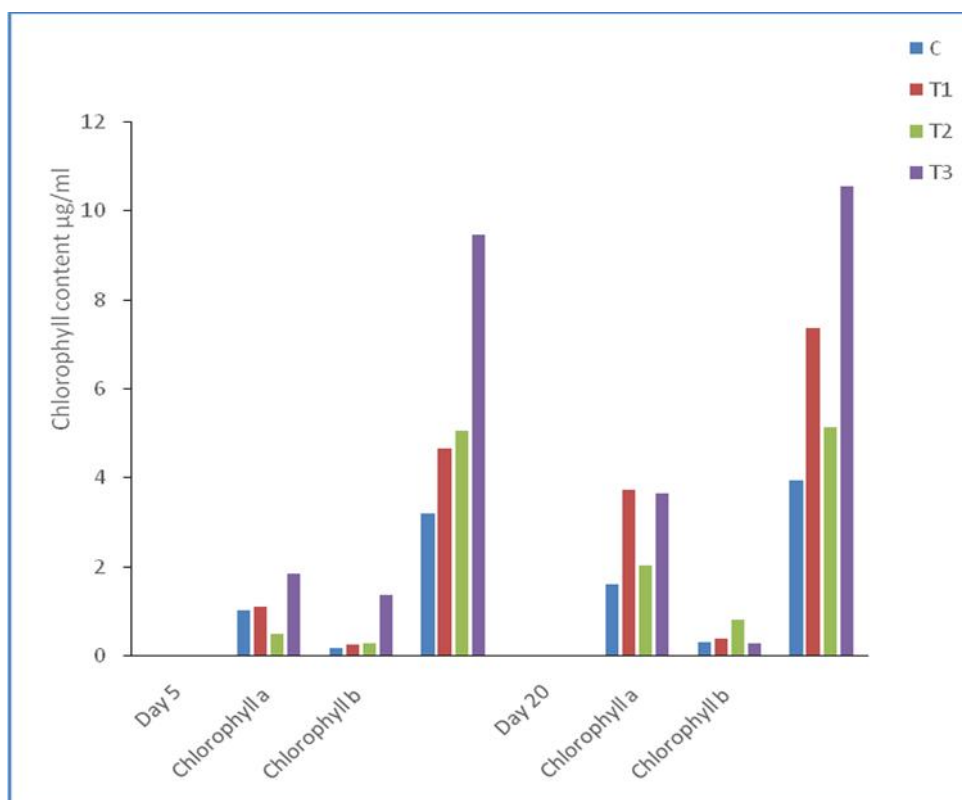


Fig: 2 Effect of selective blue green algae on the chlorophyll contents of paddy seedlings

Ecological disruptions were managed by biofertilizers. Since they are cost-effective, and eco-friendly which could be produced in large quantities in the farm. Sarbanika (2021) reported that the biofertilizers were superior to farmyard manure and other types of manure like N, P, K. When such biofertilizers applied continuously (3-4 years) in the crop field which have sufficient number of multiplied organisms lead to initiate the increase in the quantity of soil nutrients which is most essential for crop growth. The current work has suggested that the seedling stage of paddy crop was treated with blue green algae mixture promoted the growth when compared to non- treated control plants. It might be applicable for other cereal crops also.

Conclusion

Natural population of cyanobacteria exists in most paddy field soils which provided a free source of nitrogen in the fixed form. The present research was concentrated on the seedling stage of Paddy crop which treated with single and dual application of *Phormidium* and

Merismopedia under laboratory condition. Compare to other cereals, Paddy is the staple food in Sivaganagi district and it was cultivated in fields at three seasons (December, January and March). However, there has been seedling research on paddy crop along with the blue green algae which enhanced the seedling growth by increasing photosynthetic activity and also improve the soil fertility. This blue green algal technology in today's agriculture crop management system improved the crop growth at early stage which led to develop the crop to boost up high quality grain yield.

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