

ENHANCEMENT IN SEED PRODUCTIVITY OF SUNFLOWER PLANTS BY APPLICATION OF BLUE-GREEN ALGAE AS BIOFERTILIZERS

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ABSTRACT

The use of latest innovations in agriculture arena has resulted in significant increase in productivity. Fertilizer nitrogen will continue to serve for increasing grain production until a foreseeable future but efforts should also be oriented towards augmenting biological nitrogen fixation considering a growing concern about the adverse effects of indiscriminate use of chemical fertilizers on soil productivity and environmental quality.

The blue green algae as a biofertilizer is a strong alternative of chemical fertilizer in improving the soil quality. The blue green algae have inhabited much of the surface of the earth for billions of years and today they are responsible for a significant amount of biological nitrogen fixation (BNF). The blue green algae as biofertilizers are becoming a great tool in improving the environmental health.

The effect of blue green algae was observed on number of seeds of sunflower plants. For studies, the Sunflower (*Helianthus annuus*, L.var. KBSH-1) plants were taken in the experiment. These plants were raised in soil-pot culture conditions. The different supply levels of biofertilizers, nil (control), 50, 100, 150, 200 and 250 g bga/kg soil were supplied to the Sunflower plants. Number of seeds per sunflower plant increased with the increase in bga supply level upto 250 g bga/kg soil level.

Keywords: Sunflower, bga, BNF, controlled condition.

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Introduction

There is a great role of blue green algae in sustenance of soil fertility by enhancing the quantity of various nutrients in soil. In addition to this, bga also improve the nitrogen content of soil (Mishra 2022).

The tropic independence of blue green algae made them suitable for use as biofertilizers. The bio-fertilizers, otherwise called microbial inoculants are preparations containing live or latent cells of efficient strains of nitrogen fixing micro-organisms used for seed or soil application (Mishra 2020).

Blue green algae are widely distributed organisms all over the world and can be found in extreme habitats, from hot springs to arctic regions. Among the ecosystems in which they can be found, wet soils provide an ideal environment for blue green algae to grow. Blue green algae represent a small taxonomic group of photosynthetic prokaryotes of which some of them are able to do nitrogen fixation and also possess a tremendous potential for producing a wide range of secondary metabolites (Mishra 2020).

Blue green algae have drawn much attention as prospective and rich sources of biologically active constituents and have been identified as one of the most promising groups of organisms capable of producing

bioactive compounds (Fish & Codd 1994), (Schlegel et al.1999). De (1939) attributed the natural fertility of flooded rice field soil and its maintenance to the process of biological nitrogen fixation by blue green algae.

The blue green algae as biofertilizers are proving to be strong alternative of chemical fertilizer, and thus improving the environmental health. In addition to this, blue green algae are imparting a great contribution towards establishment of strong biodiversity on the planet (Mishra2022). Rai et. al., (2000) reported that blue green algae are good colonizers of the nitrogen poor soils, and that through their nitrogen input into the environment they may help to create habitats suitable for other species.

Jacq and Roger (1977), Roger and Kulasoorya (1980) and Omar (2001) reported blue green algal cultures or extracts enhanced germination, promoted growth of roots and shoots and increased protein content of the grain. The effect of nitrogen fixing blue green algae that were isolated from saline soils on growth and yield of rice grown in the green house and field were studied by Anonda et al. (1990). Under green house conditions, the N₂ content in straw, grain yield and protein content of rice were significantly increased.

The biofertilizers contains beneficial

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microorganisms which improve plant growth and protect plants from pests and diseases (El-yazeid et.al, 2007). The role of soil microorganisms in sustainable development of agriculture has been reviewed (Lee and Pankhurst, 1992, Wani et.al.1995). Biofertilizers are important components of integrated nutrients management. These potential biological fertilizers would play key role in productivity and sustainability of soil (Mishra2020). They are cost effective,eco-friendly and renewable source of plant nutrients to supplement chemical fertilizers in sustainable agricultural system (Mishra2022).

Material and Method

Experimental plants were raised in soil culture under pot culture conditions in the laboratory. Plants were raised in 8” clay flower pots with a central drainage hole. The inner surface of the pots alongwith top 3” of outer rim was lined with acid washed polythene provided with a central hole superimposed on the drainage hole of the pot. Normal water was used during culture work. All the plants were raised in the soil.1.5cmdeep holes were made with glass rod of 3mm diameter and seeds were put in these holes carefully, covered loosely with soil of the same pot. After the seeds emergence, plants were thinned to a uniform number in each pot. Subsequent thinning was done whenever needed.

The experimental pots were arranged in north-south direction and were kept raised from the ground at a height of one feet avoiding any surface contact of the drainage holes with the ground to eliminate any contamination.

For studies, the Sunflower (*Helianthus annus*, L.var. KBSH-1) plants were raised in soil pot culture. Soil samples were collected in a clean polythene bag after surface scrapping and brought to the laboratory. Calculated amounts of normal water were applied daily to pots to provide as for as possible uniform soil moisture conditions. Sampling was generally

started at 8:30A.M. and completed in an hour. All samples were drawn at the same time and placed in the shade.

Soil was separately mixed with required amount of blue green algae. There after it was air dried, thoroughly grounded and mixed. For thorough mixing required amount of BGA were mixed with small amounts of soil, divided and mixed again and again. Then these amended soils were mixed with bigger amounts of soil similarly, and finally these soils were mixed with bigger lots of calculated amount of soils required for experiments. Soil mixing was done on separate clean chart to avoid any contaminations. Mixed soils were filled in pots.

Twenty healthy seeds of *Helianthus annus* were spread uniformly in each pot, where one pot with controlled treatment and other with blue green algae treatment. Normal tap water was applied to the two sets of pot. The seeds were allowed to germinate in alternate light and dark conditions. The number of seeds were counted once the plants got matured i.e. at the age of 100 days.

Result

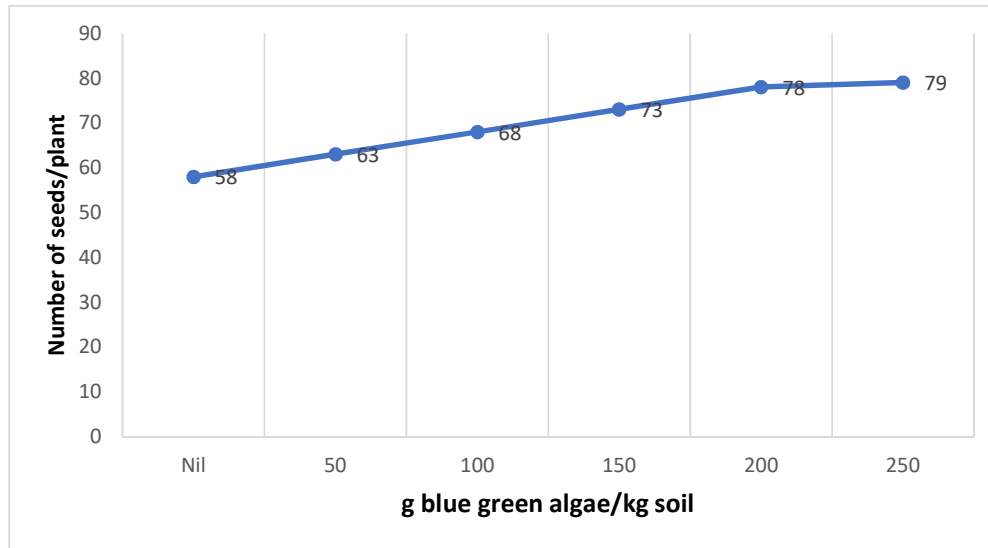
The various supply levels of blue green algae as biofertilizers leave impact on the growth and composition of sunflower plants.

Number of seeds per sunflower plant increased with the increase in bga supply level upto 250 g bga/Kg soil level and increase was found to be highly significant (P = 0.01) at each level of supply over control. Except at 250 g bga/Kg soil level over 200 g bga/Kg soil level, where increase in number of seeds failed to show any significant difference, all other levels such as 200 g bga/Kg soil over 150 g bga/Kg soil, 150 g bga/Kg soil over 100 g bga/Kg soil, and 100 g bga/Kg soil over 50 g bga/Kg soil showed highly significant (P = 0.01) increase in number of seeds per sunflower plant. Maximum number of seeds per plant was observed at 250 g bga/Kg soil level.

Effect of the blue green algae as biofertilizers on number of seeds of Sunflower (*Helianthus annus*, L. var. KBSH-1) plants

Plant		g blue green algae/kg soil					
Age (days)	Part	Nil	50	100	150	200	250
Number of seeds/plant							
100	Seeds	58	63	68	73	78	79

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Discussion

The idea of inoculation of biofertilizer was indirectly known to our ancestors when they transferred large amounts of soil from areas where leguminous crops were flourishing to areas where they were less luxuriant. In a sense, they were inoculating nodule forming bacteria from one field to another. With the advent of an energy crisis, non-symbiotic nitrogen fixing micro-organisms got their due emphasis and applied research took shape in developing countries. Nitrogen fixing bacteria and blue green algae and aquatic Azolla containing nitrogen fixing blue green alga Azolla anabaena were highlighted.

Biofertilizers such as rhizobium, Azotobacter, and blue green algae are being used since long time. The blue green algae is used as a important tool to maintain the sustenance of the biodiversity.

The use of blue green algae as nitrogen based biofertilizers is reported from various countries of the world. This is because of the increased cost of chemical fertilizers. At the same time, these chemical fertilizers cause soil and water pollution, changes soil structure. In comparison, blue green algae is a cheap source of N, which does not cause pollution. It improves the organic matter status and water holding capacity. Venkataraman (1981) reported that open air soil culture is simple, less expensive and easily adaptable by farmers. As mentioned earlier, blue green algae had minimum growth requirements of sunlight, simple inorganic nutrients and moisture.

In 1977 Verghese stated that the demand for chemically fixed nitrogen is bound to be on increase and the nitrogen gap is likely to double in India by 1984, which would be difficult to bridge in the wake of the energy crisis.

Blue green algae dominate a wide range of diverse environments characterized by extremes of temperature, desiccation, pH, salinity, light intensity and nutrients (Whitton, 2000). Many blue algae tolerate high levels of ultraviolet radiation (Sinha et al, 1999), permitting them to survive at the soil surface.

Many blue green algae have the capacity to manufacture nitrogenase. Because the enzyme complex is anaerobic, significant fixation by unicellular, colonial and

some filamentous species occurs only in the absence of air. Therefore, only heterocystous species are valuable as biofertilizers. Blue green algae i.e. biofertilizers have several advantages over chemical fertilizers. They are non-polluting, inexpensive, utilize renewable resources. Besides supplying N₂ to crops, they also supply other nutrients such as vitamins and growth substances (Wagner, 1997). Anabaena and Nostoc have been recorded among the common nitrogen fixing blue green algae in rice fields.

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The current study was preformed to assess the effect of nitrogen fixing blue green algae to improve the natural poor sandy soil. The data presented revealed the beneficial use of blue green algae in comparison with the controlled (untreated soil) soil conditions. The aim of the present study was to design a soil system supported with microalgae and other soil conditioners that change the physical and chemical properties of that system in order to improve the surrounding environment of crop plants. It is evident from the present results that the inoculation of the different microalgal species to the investigated soil caused a significant enhancement of both physical and chemical properties of soil.

The blue green algae as a biofertilizer is becoming to be a great substitute of chemical fertilizer in enhancing the soil properties. The main objective of applying inoculants is to increase the number of such microorganisms in soils or rhizosphere and consequently

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improve the extent of micro-biologically fixed nitrogen to plant growth. Application of bio-fertilizers in combination with organic nitrogenous fertilizers has a key role to play in the economic management of nitrogen needs of crops. In India, considerable progress has been made in the development of blue green algae based bio-fertilizer technology.

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