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AN OVERVIEW OF BLUE GREEN ALGAE (CYANOBACTERIA) AS A USED OF BIOFERTILIZER.

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Abstract:

As the population in India is increasing the demand for more food lead to increase in the pressure on the Agricultural land. Because of this, the requirement of food products in less time has lead to excessive use of chemical fertilizers in the agricultural field. The use of chemical fertilizers has harmful for not only the agricultural land and surrounding environment but also to the human healthcare. In this situation the use of biofertilizer has become the need for 21st century for sustainable agriculture in India. Biofertilizers like Blue Green Algae (Cyanobacteria) has a significant role in various aspect of agricultural field. It increases the fertility and aggregation of soil and makes atmospheric nitrogen available for plants which ultimately lead for the growth of the crops. Blue Green Algae (Cyanobacteria) has a wide range of application from crop production to soil fertility and even it helps in aggregation of soil. This review covers few important applications of Blue Green Algae for crops, soil and sustainable agriculture development in India.

Keywords: Blue Green Algae (BGA), Biofertilizer, Cyanobacteria, Agriculture.

Introduction:

Blue Green algae (BGA) comes under the group of Cyanophyta. This group of algae also known as Cyanobacteria due to its prokaryotic nature. It is the oldest form of life on earth, and is a group of gram negative photosynthetic bacteria which colonizes the earth surface 3.5 billion years ago. BGA has a wide range of application for plant growth; it has a unique function of fixing atmospheric Nitrogen due to a specialized cell called heterocyst. In Cyanobacteria under aerobic condition, nitrogen fixation occurs in the specialized cell called Heterocyst. There are about more than fifty species of Blue Green Algae (BGA) are known to fix atmospheric nitrogen, these species are mainly belonging to the genera *Anabena* sp., *Anabaenopsis* sp., *colothrix* sp., *Cholorogloea* sp., *Cylindrospermum* sp., *Fischerella* sp., *Hapalosiphon* sp., *Mastigocladus* sp., *Nostoc* sp., *Scytonema* sp., *Stigonema* sp., *Tolypothrix* sp., *and Wetiellopsis* sp. These all forms fixing nitrogen are filamentous and heterocyst bearing members of the order Nostocales and Stigonematales (Mazid 2011b). *Nitrogenase* is the enzyme which is found in the heterocyst is the multicellular enzyme and contains *Nif* genes and made-up of two component one is large (Fe Mo protein) and other is Small (Fe Protein). Large

component also known as Dinitrogenase has catalytic activity and small group is Dinitrogen reductase, both are highly sensitive to Oxygen. This Complex after oxidation fixes atmospheric nitrogen as ammonia which is used by various plants for their growth and development.

The effect of Biofertilizers like Blue Green Algae has been seen on the rice field over the years it significantly increases the yield without of a much efforts. Blue green algae not only helps in the growth of plant due to its nitrogen fixing ability but also increases the soil aggregation and porosity. Biofertilizers are biologically active as it increases the activity of microorganisms, colonizes the rhizosphere and promotes growth by increasing the availability of nutrients to the plants (Mazid *et.al.* 2011). Dependency on the chemical fertilizer can decreases the fertility of the soil and can decreases the natural nutrients available for plants in the agriculture (Barman et.al. 2017). Plants cannot uptake all the nutrients which are required to their growth and development applied by chemical fertilizers to the agriculture field (Bhardwaj *et al.* 2014) because of this some amount of nutrients are either fixed in the soil through some practices to increase the fertility and nutrient or through mixed with water bodies (Mahdi *et al.* 2010). Biofertilizers not only saves chemical fertilizers and its cost but also help in its utilization effectively which increases the yield rates (Ghosh 2004). To make agriculture sustainable it is very necessity to make the balance in between the agriculture and environment so for that the eco-friendly products need to use for the development of plants in agriculture. (Venkataraman & Sundaram, 1992; Mahdi *et al.* 2010) Biofertilizers will be the good option to make the balance and for the sustainable agriculture (Pindi & Satyanarayana, 2012; Borkar, 2015; Barman *et.al.* 2017). Blue green algae have been used in the economic development and environment management like wastewater management and atmospheric fixation of nitrogen. Application like Agriculture, Food, Feed for Animal and Aquaculture, Antibiotics, Pigments and Natural color etc. will be helpful for that. (Chakdar *et.al.* 2011).

Sustainable Agriculture:

Rice is one of the important food crops of worlds because more than 40% of the world's population depends on rice as a major source of calories. In India the production of Rice yield is about 1990 kg/ha compare to a maximum of 3346 kg/ha in Punjab. So the production of rice yields in Punjab is highest in the country but low compared to China i.e. 5807 kg/ha. (B. D. Kaushik 2014). Blue Green Algae (Cyanobacteria) is known for their Nitrogen fixing ability, over 100 species of BGA are known to fix atmospheric nitrogen. Over the period of time they have found to be very effective on rice and banana field. Particularly about rice plantation the submerged condition has help really well to BGA growth which ultimately helps to the growth and development of rice.

In India the states like Punjab, Uttar Pradesh and Haryana are the states were the production of rice is higher as compare to the other states. And the study has shown as use of BGA resulted in 25.2% of urea reduction with an overall of 3.8% increase in the yield of rice and a marginal decrease in per acre cultivation cost (Bhooshan *et. al.* 2018). Apart from rice the effect of Blue Green Algae (Cyanobacteria) as a Biofertilizers was seen on the wheat plant. Vermicompost and Farmyard Manure (FYM) enhances the abundance of BGA like *Nostoc* sp., *Anabaena* sp., *Calothrix* sp., *Oscillatoria* sp., and *Phormidium* sp., under the wheat crop which ultimately increases the yield of Wheat (Prasanna *et.al.* 2008).

Treatment of Algalization can enhance crop yields (Rodgers *et al.* 1979; Singh 1988; Pachpande 1990). Most of the Cyanobacteria can fix nitrogen to ammonia which is then used for amino acid and protein synthesis. Pre-soaking of seeds of pumpkin and cucumber with a Cyanobacteria extract can enhance their growth and germination (Nanda *et.al.* 1991). There are some other Biofertilizers other than BGA like Farmyard Manure (FYM) and Vermicompost is good for Sustainable agriculture. Blue Green Algae (BGA) has been successive to the rice field over the years but it has been observed that Blue green algae along with Vermicompost and Farmyard manure has shown significant results to crop growth like chilli (Sangita, 2015; Sundaram *et.al.* 2019). Beside these natural abilities of Cyanobacteria, fixing nitrogen, improving soil quality and balancing mineral nutrition in the soil. Many Cyanobacteria are known to release biologically active substances like vitamins, carbohydrates, amino acids, proteins, polysaccharides and phytohormones that function as elicitor molecules to promote plant growth and development which help them to fight against biotic and abiotic stress (Singh 2014).

Soil Fertility:

It has been observed that the algae particularly blue green algae increases the soil aggregation and water holding capacity of soil which ultimately helps for the agricultural practices for crops. Most of the *Nostoc* sp., and *Oscillatoria* sp., species increases the aggregation and water holding capacity of soil (Bailey *et.al.* 1973). Nitrogen fixing blue green algae significantly increases the nutrients and increases the fertility of soil (Shariatmadari *et.al.* 2011). Soil aggregation increases the porosity of soil and makes it retain more water. In some of the experiment the surface blue green algae effect on physical properties of soil. *Nostoc muscorum* inoculums positively effects on the microbiological, biochemical, and physical properties of soil (Rao & R.G. Burns 1990). Over the years Blue Green Algae effect as biofertilizer was seen on the rice fields but for Pea plant two species of Blue Green Algae (Cyanobacteria) i.e. *Nostoc entophytum and Oscillatoria angustissima* inoculums were tested as Biofertilizers; Inoculation of soil with a suspension of each species or a combination of the two species significantly increases the germination percentage and stimulated the other measured growth parameters and photosynthetic pigment fractions of pea plant (Osman *et.al.* 2010). Biofertilizer contains living microorganism which when applied to the soil it increases the availability of nutrients that can improve soil fertility. Ultimately these Biofertilizers helps legumes in improving the soil fertility and increases the activity of microorganisms are used for application to seed (Mazid *et.al.* 2011). The use of algal growth has significantly increases the fertility of soil with residual effect on succeeding crops (Kant *et.al.* 2006). The Diazotrophic Cyanobacteria can increase the fertility of soil especially under rice plantation. These algae enhances the growth promoting factors in the soil like vitamins and amino acids, adds good amount of organic matter to the soil and solubilizes the insoluble phosphate which increases the physical and chemical nature of soil (Goyal 1993). Blue Green Algae (Cyanobacteria) has tremendous role in build-up soil fertility which enhances the yield of crops. For organic farming the use of Biofertilizer being essential components and play major role in maintaining long term soil fertility and sustainability by fixing atmospheric dinitrogen (N=N), mobilizing fixed macro and micro nutrients and convert insoluble phosphorus in the soil into the forms which can be available to plants for uptake and can use it in the development and growth of the plants (Sahu *et.al.* 2012). Ultimately the use of Biofertilizers like Blue Green Algae (Cyanobacteria) will significantly enhance the quality of soil which will be beneficial for the agriculture in future. It cost lower than the chemical fertilizers and will be a good balance in between nature and the agriculture practices for sustainability.

Conclusion:

Over the years we have witnessed the application of Blue Green Algae (Cyanobacteria) in the rice plantation. But apart from that these Biofertilizers has shown a tremendous result for other crops like wheat, pea, maize and cotton. Biofertilizers are cost effective and very important to make sustainable agriculture development. It increases the soil fertility and dissolves the insoluble phosphate and makes it available for plants to grow. It also enhances the several Micro and Macro components like Vitamins, Carbohydrates, amino acids and proteins in the soil which are vital for the plants under varies stresses. These Biofertilizers are good alternatives source to chemical fertilizers. Which are high in cost and harmful for humans, environment and for soil fertility. For Sustainable agriculture development,s Biofertilizers like Blue Green Algae (Cyanobacteria) are the bright side to change the course of Indian Agriculture for betterment of the society.

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