International Journal of Modern Agriculture, Volume 10, No.2, 2021
ISSN: 2305-7246

Cyanobacteria: A Source Of Bio Fertilizers For Sustainable Agriculture

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Abstract

Constant increase in the global human population and the degradation of the natural energy resources causing harm to environmental needs, sustainable food supply and the energy supply. The most environmentally friendly 'carbon technology' strategy has been used for the preparation of biofertilizers. The indiscriminate rise in the human population and the growth has put an extra burden on the resources of soil and water. Compared to other species, micro-algae and cyanobacteria are environmentally friendly, greater cell size and effective production of biomass, making them the easiest and most sustainable alternative to the problems of soil fertility and the water supplies available. Over the course of the evolution cyanobacteria are by far the most productive and maintained prokaryotic organism. They are regarded one of the earliest forms of life found on this planet. Cyanobacteria are evolving prospects for converting radiant energy effectively into chemical energy. As a by-product this biological system generates oxygen. Regularly, cyanobacterial biomass could be utilized for gigantic scope food, power, auxiliary metabolites, bio fertilizers, beauty care products, and meds handling. Accordingly, cyanobacteria are regularly utilized for preparing biomass of very high worth and bringing down the measure of CO2 in harmless to the ecosystem supportable horticultural practice. This paper talks about the large scale manufacturing strategies for the cyanobacteria bio fertilizers and their use in the farming and in industry

Key words: Biofertilizers, Cyanobacteria, Medicines Processing, Sustainable Agriculture, Soil Fertility.

Introduction

The most common group of species on earth are the cyanobacteria. They are autotrophic which occur in a particular atmosphere, particularly in the fields of water and sea. Sea water is the most powerful source of nutrition for production of cyanobacteria. In specific, they are small and unicellular and grow mostly in large colonies. Cyanobacteria encompass a wide range of different kinds and sizes of organisms. It will cover 150 species as of now. These have features of around 3.5 billion years ago, the earliest fossils. These also have an evolutionary meaning, as they are essential for the oxygenic climate of today [1].

Cyanobacteria classification introduced in 1985, wherein four orders of bacteria were known as Nostocales, Chroococcales, Stigonematales and Oscillatoriales and their phyla were Gloeobacterales, Pleurocapsales and Chroococcales respectively. Cyanobiology is associated with the plant origin eras. In the course of growth and environmental change in global history, Cyanobacterias are of vital importance [2]. Cyanobacteria began living inside some eukaryote cells in the late Proterozoic or early Cambrian time frame, such occasion is called endosymbiosis, for the cause of the eukaryotes. They can fix the air nitrogen so it very well may be utilized uniquely as a bio fertilizer to develop yields of financial significance like beans and rice. Outside most cyanobacteria cells are made of a few particular kinds of cells, including an adhesive sheet, cell divider, and plasma film at the deepest. The cytoplasm incorporates pigmented lamellae that are not plastid-coordinated. Chlorophylls, xanthophylls, carotenes, are remembered for the shades [3].

The world's present populace is 7.7 billion and is anticipated to surpass 8.7 billion by 2030’s, 9.9 billion by 2050, and about 11.3 billion by 2100’s. As the total populace develops, individuals need to build our oat creation, however because of land requirement, as it doesn't develop step by step, individuals need to think about a few different ways to take care of our populace later on [2]. This point is a critical weight to accomplish food security for the cultivating area. This objective must be refined by bringing more land under development or by expanding the profitability of existing cropland. As the main option isn't accessible, so that all can find another way to improve the yield efficiency due to land impediment. Best practices to improve the efficiency are soil fruitfulness upgrade and the utilization of eco-accommodating strategies in ordinary cultivating. Our horticulture right now depends on compound manure, pesticides, through water system and so forth Such customary exercises mess up the environment and wellbeing, similar to loss of soil richness, abuse of the land and water supplies, sullied air. Manageable cultivating practices will take care of all rising food issues, and natural quality issues. One of the best regular methods of accomplishing great outcomes is among this biofertilizer. Biofertilizers are the living microorganisms, fit for emitting explicit natural mixtures in the dirt that upgrade seed development, plants. It likewise safeguards the equilibrium of indispensable supplements like phosphate, nitrogen, potassium and different supplements of mineral root Biofertilizers can be ordered by the microorganisms and their application, similar to phosphates, nitrogen fixators, biofertilizers that are potassium-solubilizing and biofertilizers that activate phosphorus. Plant development advancing rhizobacteria and zinc-iron solubilizers are another class of biofertilizers for the optional macronutrients .

1. Cyanobacteria use as a biofertilizer

Cyanobacteria are microorganisms which are evolving for the sustainable agricultural production. Figure 1 has a theoretical representation showing the possible roles of cyanobacteria in the environment and the sustainable agriculture. Diazotrophes are cyanobacteria that are useful for the generation of readily available and less expensive eco-friendly biofertilizers. They could monitor the plant nitrogen deficiency, increase soil aeration, keep capacity for water and add vitamin B12. *Aulosira fertilisima, Anabaena variabilis, Nostoc linkia, Tolypothrix sp., Calothrix sp.,* are the most effective cyanobacteria existing in the region [4]. *Anabaena* may repair 60 kg/ha per nitrogen season and also enhances organic soils. Cyanobacteria do not need a host of valuable organic products for their development, growth, and production. The relationship Azolla-Anabaena is taken an illustration of advantageous interaction in the rice paddy area for nitrogen obsession and supplement advancement. They exhibit lysis of cell divider lignin and delivery phenolic intensifies that caused the organic entity's abundant sporulation. These biofertilizer applications have been recorded in cotton, grain, maize, tomato, lettuce, oats, radish, , sugarcane [5].

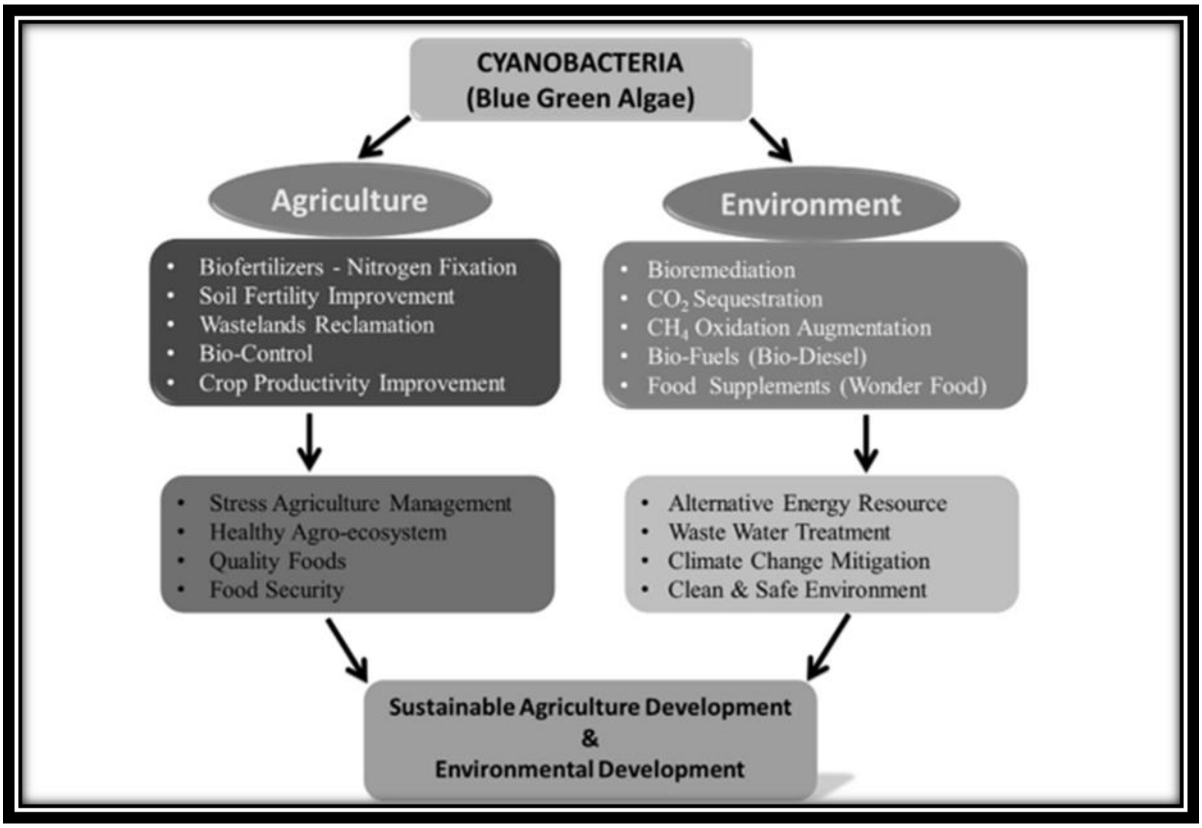

Figure 1: shows the Sustainable Agriculture and the Environment's Potential Functions of Cyanobacteria

Song and others reported that the cyanobacteria perform a leading role in soil's fertility maintenance and production, thus yielding as a natural biofertilizer (Figure 2: Developing sustainable agricultural practices through the use of beneficial results of the cyanobacterial growth). Blue-green algae's main actions include [6];

(a) Making permeable soil, and making sticky substances.

(b) Phytohormone discharge (gibberellins, auxin, and so on), nutrients, and amino acids.

(c) Increase the capacity of soil holding water by its trademark jam structure.

(d) Soil biomass increment after its destruction and deterioration.

(e) Decrease in saltiness in soil.

(f) Weed control.

(g) Soil phosphate creation by the discharge of the natural acids.

(h) Efficient substantial metal retention (bioremediation) on the microbial surface.

Chemical fertilizer applications have been extensively used for several decades. Their regular use triggers the environmental and crop adverse effects. The primary motive behind its applications is increasing crop yield. There are several beneficial sides of bio fertilizers without any harmful effects on humans. Bio fertilizers are organisms that cause soil nutrient enrichment by increasing nutrient availability for crops (Table 1).

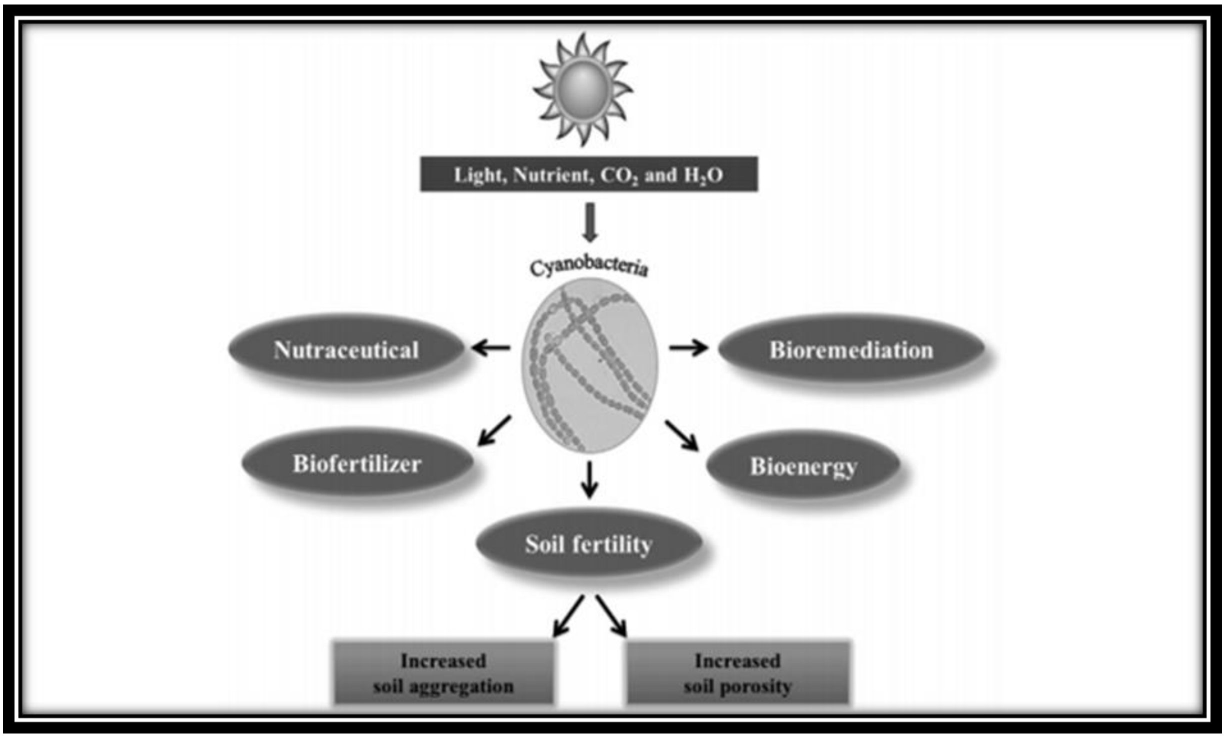

Figure 2: Shows the Utilization of Beneficial Outcomes of Cyanobacterial Growth for the Development of Sustainable Agriculture Practices.

Table 1: Different Types of Organism as Bio fertilizer

S. No	Types of nitrogen-fixing organisms
1.	Free-living nitrogen-fixing bacteria: *Azotobacter, Bacillus polymyxa, Clostridium, Beijerinckia*
2.	Free-living nitrogen-fixing cyanobacteria: *Anabaena, Nostoc, Aulosira, Tolypothrix, Cylindrospermum, Stigonema*
3.	Nitrogen-fixing bacteria with the loose association: *Azospirillum*
4.	Symbiotic nitrogen-fixing bacteria: Various species of Rhizobium: *R. leguminosarum, R. lupini, R. trifolii, R. meliloti, and R. phaseoli*
5.	Symbiotic nitrogen fixing: *Azolla pinnata and nitrogen-fixing cyanobacteria*
6.	Microphos biofertilizers: *B. polymyxa, Pseudomonas striata, Aspergillus species*
7.	Mycorrhiza: Symbiotic association of a fungus with the root of a higher plant

2. Production of cyanobacterial biofertilizers

In view of the helpful properties of cyanobacteria just as other microalgae in different areas their immense scope development has been conceivable. The main factor that characterizes the feasibility of huge scope biomass creation of monetarily critical items is monetary maintainability [3]. The presentation of cyanobacteria development is dictated by five fundamental abiotic boundaries: pH, light, temperature, carbon dioxide, water, and supplement supplements (C, P, N, Fe, S, K, and so forth) To control these factors, tremendous aptitude and assets are required. A few cyanobacteria and microalgae, as Dunaliella, Haematococcus, Chlorella, and Arthrospira, have been developed as monetarily and financially feasible harvests on a wide scale. Commercial development of photosynthetic micro-organisms can be realized in various ways [7]:

(a) Open framework cultivation using daylight
(b) Closed framework cultivation using daylight
(c) Closed framework cultivation using artificial source of light

2.1 Open system cultivation utilizing sunlight

Natural sunlight is the energy source in open cropping systems. Cyanobacteria and microalgae are used for mass cultivation of the circular or raceway form shallow ponds in the open grounds. There are considerable benefits, and the drawbacks compensate for the total production cap for biomass[4].

Advantage:

- Cost free solar radiation

Disadvantage:

•Contamination by nibblers, green growth, and other miniature life forms is unavoidable, which antagonistically influences net profitability.

Defilement issues might be forestalled for life forms requiring unmistakable development conditions that typically forestall the improvement of different creatures, however this methodology restricts the utilization of open frameworks for development of just assigned organic entities Example: In Mexico, the China, USA and Thailand, spirulina was broadly developed utilizing the open strategy under explicit development necessity [5].

2.2 Closed system cultivation utilizing sunlight

Solar rays are a source of energy in this framework. The straightforward material for example plastic or glass is being utilized to make vessels that are set outside for the brightening in the normal light [1].

Advantages:

- Assists in preventing grazers and competitors from contamination.

• Contains a better volume-to-volume ratio and cell densities than the one in open systems.

Disadvantages:

- By using transparent materials, the expenses for these devices are greatly increased.
- The removal of photosynthesis of oxygen and the conservation of optimal temperatures are also important components in closed systems [8].

To preserve these parameters, several techniques have been developed; The cost of using natural sunshine usually exceeds, however, the competitive edge.

2.3 Closed system cultivation utilizing artificial light

In this device artificial light is the source of radiation. Photobioreactor is being used to evolve diverse species. Photobioreactor are closed tubes, similar to traditional light-driven fermenters. Using software, all parameters for real-time control and culture are optimized. Photobioreactors function as an important method for processing high-value products, including stable biochemicals marked with isotopes. These structures are also appropriate for the development of GMOs [9].

In any case, utilizing such techniques, the expenses can be adjusted by handling superior grade, amount biomass. Four different procedures like solidified tank measure, shallow metal box measure, polythene lined pit interaction, and field technique have been utilized for the mass development of the cyanobacteria. The polythene lined framework is generally suitable for the readiness of the biofertilizer for minor and minimal ranchers. Little pits are set up in the field and loaded up with thick sheets of polythene, for example, Aulosira, Nostoc, Gloeotrichia, Tolypothrix utilized for the inoculum planning [11].

3. Potential roles of cyanobacteria in the sustainable agriculture

There is worldwide worry about the aimless utilization of fake nitrogen composts in the agribusiness. Contemplations of the supportability request that options in contrast to the nitrogen composts ought to be sought after direly. This option is given by the natural nitrogen obsession, a fungal interaction that changes climatic nitrogen into a utilitarian plant structure. Nitrogen-fixing frameworks give a monetarily attractive and ecologically maintainable approach to lessen outside information sources and lift inward proficiency [6].

The cost of manufacturing inorganic nitrogen fertilizers is large. Nitrogen deficiency in crops is met sustainably through the use of biofertilizer. Cyanobacteria are a biofertilizer instance, they could fix lesser than 10 kg/ha of Nitrogen. About annually [9]. Dense mats of cyanobacteria are estimated at 10-30 kg/ha of nitrogen. Cyanobacteria are involved in nitrogen, starch, and oxygen cycle. They can live in wet soils and have a major effect on nutritional status, structural stability and the productivity of crops. Continuous changes take place at molecular level necessary for the survival under high UV radiation intensity (281–410 nm), temperature variation desiccation, and condition of the high salinity throughout evolution. They are all favorable conditions which provide defense from other competitors which grazers.

Certain employments of advantageously related cyanobacteria in the bioremediation and improvement of exopolysaccharides (EPS) of contaminated soils or sea-going frameworks. The EPS goes about as a sticking specialist for totaling soil particles, gathering natural matter and expanding the capacity of the top layer of soil to hold water. PGPRs along with cyanobacteria producing EPS can lead to the soil infertility improvement and reclamation.

Conclusion

There is a growing potential for cyanobacteria as just a biofertilizer. They are equipped for utilizing CO2, supplements, and water to transform sunlight based energy into the biomass. Successful uses of the cyanobacteria in horticultural practices have been accounted for to moderate an Earth-wide temperature boost by lessening CO_2 discharges. As per the general report, cyanobacteria biomass could be utilized to improve the nature of the food items, soil physicochemical qualities, oversee soil-borne sicknesses, discharge development advancing mixtures, solubilize insoluble phosphates, add natural matter, utilizing as nutraceuticals and even use in pharmaceutics. Biofertilizers made from cyanobacteria are both environmental and economically friendly.

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