

# Algae as a Soil Conditioner

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**Abstract**— Field trials were conducted to check the ability of algal fertilizer and is compared with different organic and inorganic fertilizers. Some of the extremely good algal species were checked on the basis of nutrient content and utilized as bio fertilizer in laboratory as well as in field and shown outstanding results. The result includes good water holding capacity of soil, well aeration to root part, good soil binding capacity and supplement of continuous and calculated nutrient to the soil. The effectiveness of algae as a soil conditioner can be indicated by average improvement in physio- chemical property of soil or improvement in plant growth. This reduces ill effect of chemical fertilizers eco friendly and shows sustainable results. Modern world is moving towards a life with balanced eco system which is obtained by modern generation bio fertilizer made of algal species which shows better results.

**Index Terms**— Algal bloom, algal fertilizer, B.G.A, soil-acidification, soil nutrients.

## I. INTRODUCTION

Word soil conditioner refers to the chemically biologically prepared substance used for the nourishment of soil which essentially helps in growth of various plants. The word soil conditioner somehow differs from fertilizer. Fertilizers only supply nutrient to the soil but soil conditioner enhances the physical, chemical and biological health of soil. It increases aeration, water holding capacity, nutrient viability to the soil due to which soil texture and its quality also get improved which supports vegetation. It brings down the essential elements and mineral, in a compact amount to the soil which upgrades the soil quality and makes it fertile. The mostly used fertilizers are of different types, such as organic and inorganic fertilizer which includes DAP, vermicompost, farmyard manure, etc.

John Bennet Lawes, an English entrepreneur, began to experiment on the effects of various manures on plants growing in pots in 1837, and a year or two later the experiments were extended to crops in the field. One immediate consequence was that in 1842 he patented a manure formed by treating phosphates with sulphuric acid, and thus was the first to create the artificial manure industry.

Agriculture sector is focusing on research method to find effective bio fertilizer which promotes crop yield and at the same time do not cause damage to the ecosystem. Fertilizers provides various essential nutrient which is added to the soil and taken by plants for better growth[2]. They are broadly classified into *macro and micro nutrients*. Macronutrients are

utilized in large quantities, present in plant tissue in amount from 0.15% to 6.0% on dry matter basis where as micronutrients are consumed in smaller quantity which are present in the plant tissue ranging from 0.15 to 400 ppm or less than 0.04% on dry matter basis[2].

The other three important elements needed by all plants are carbon, hydrogen and oxygen, supplied by water through rainfall or irrigation and carbon di oxide is supplied through atmosphere. In the newly revolution of fertilizer algae as a bio fertilizer is in research process. Algae represent a large group of micro organisms which are beneficial for enhancing soil productivity. They fixes atmospheric nitrogen and synthesise plant growth promoter. bio fertilizers are effective replacement of chemical fertilizers and also more cost effective[3]. Various fertilizers are used for different crops or plants as per their requirements, such as inorganic or inorganic nitrogenous fertilizer, phosphate fertilizer, potassium fertilizer, etc which are discussed below.

## II. DIFFERENT SOIL CONDITIONER

Soil conditioner or fertilizer are made to enrich soil quality for cultivation purpose. They are the only source which not only supply nutrient to the soil but also protect soil or plants from some of the agents which are causing damage. They provide more strength to the plant and can grow them in adverse climatic condition. There are various sources of nutrients present in our ecosystem either prepared in laboratory or grown naturally which are discussed below:

Fertilizers are mainly in the form of inorganic, organic and biofertilizers. Inorganic fertilizers are prepared chemically, classified in the form of nitrogenous, phosphate, potassium, diammonium hydrogen phosphate, etc. Nitrogenous fertilizer are simply rich in nitrogen, a mineral used by every plant for healthy growth and reproduction. Inorganic nitrogenous fertilizer comes in the form of sodium nitrate, also called chilates and ammonium nitrate, used for quickly providing nitrogen to the soil. Ammonium chloride, ammonium nitrate and ammonium sulphate are also used as general nitrogenous fertilizer[4]. Urea is an another form which contains maximum proportion of nitrogen used as a fertilizer. A major nutrient of the fertilizer is phosphate which is necessary for growth and reproduction in plants. Inorganic phosphate fertilizer comes in the form of rock phosphate, super phosphate and slag. Natural deposit of rock phosphate is in rocks where as super phosphate is manufactured from rock phosphate and slag is produced as a by product of steel mills. It is used in over acidic soil or to remove the deficiency of phosphorous in soil[4]. Potassium is a major nutrient in the fertilizer. Its organic outsource is kelp meal used to increase potassium content in soil, it should only be applied if its

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deficiency is observed. Inorganic potassium is used along with potassium chloride and potassium sulphate to enrich the soil quality. Potassium chloride is also called muriate of potash whereas potassium sulphate is called sulphate of potash. Both are water soluble hence quickly available to plants. Granite meal and green sand is also used for potassium enrichment[4]. Excess of potassium generally due to fertilizer, further aggravate the stress from the magnesium deficiency[5]. Di ammonium hydrogen phosphate is used as a fertilizer for better growth of plant, but on regular use it slightly increase the pH of soil [6]. DAP fertilizer is an excellent source of nitrogen and phosphate. It is incompatible with alkaline chemicals because its ammonium ion is more likely convert in to ammonia in a high-pH environment.

Natural form of such fertilizer are also available in our surrounding. Naturally organic nitrogen comes from by products of plants and animals. In support of nitrogenous supplement to soil oil cakes, blood meal cotton seed meal, corn gluten meal, leather and fish meal are also used for increasing nitrogenous content in soil. Its deficiency shows poor plant growth, pale green and yellow leaves, insufficient formation of chlorophyll, etc. Organic source of phosphate includes bone meal and bat guano.

Organic fertilizers are prepared from organic source which includes FYM, vermicompost, etc. FYM is one of the oldest manure used for growing crops made from decomposed mixture of dung and urine of farm animal along with their litter and left over material from fodder roughage fed to the cattle. It is rich in nutrients and increase the physical, chemical and biological property of soil[7]. The dumped manures are converted in fertilizer in 5 – 6 months. Vermicompost is one of the most successful bio fertilizer causing zero ill effect to soil or plant. It is a product of heterogeneous mixture of decomposed vegetable on food waste, bedding materials of vermicast decomposed by earthworm. These casting contains reduce level of contaminants of higher nutrient value [8]. It contains most of the useful nutrient require for the plant growth. Mostly flowering plants and fruiting plants grown by applying vermicompost and shows good and productive results hence also known as garden fertilizer.

### III. BENEFITS AND DRAWBACKS OF FERTILIZERS

Fertilizer materials are drawn from nature, and often recombined, concentrated, blended and balanced according to crop requirements. Applied fertilizer supplements the soil's shortfall in providing adequate plant nutrition to grow food. Fertilizer materials are applied in an efficient, economic and environmentally responsible manner, in order to grow the world's food supply [9].

Chemical fertilizer are causing water pollution by increase nitrogen and phosphorous level which cause some ecological problems. Some of the major disadvantages of chemical fertilizers are land degradation, heavy use of chemicals degrade health of soil, high level of chemicals are supplied directly to crops and vegetables which is not fruitful with respect to health condition. Some agricultural problems are soil acidification, trace mineral depletion[10], over fertilization[11], lack of long term sustainability on fertilizers.

All of these finally harm the ecosystem which misbalance the food chain and living organisms are main targets affected by this change. Disadvantage of complex fertilizer are some composted bio waste used as an organic fertilizer may support the growth of pathogens and other disease causing organisms if not properly composted[12]. Nutrients content are variable and their release to available forms that the plant can use may not occur at the right time of plant growth[13].

Fertilizers are beneficial and essential for providing sufficient food to the huge population but they are causing serious damage to the environment. For growing good yield farmers apply large amount of chemical fertilizers to the soil but rather than giving good yield they are destroying the soil quality. Chemical fertilizers easily dissolves in water and settles down in the earth and pollutes the underground water which results in various health problems from drinking that water. Similarly in the rainy seasons, heavy rain takes away the fertilizers to pond and river which pollutes the aquatic ecosystem. Acid rain is an another effect of chemical fertilizer. Scientists are researching the alternative of chemical fertilizer to save whole environment and ecosystem and step towards sustainable development. Using algae as a soil conditioner is one step forward in a direction to resolve these problems.

### IV. ALGAE AS A SOIL CONDITIONER

Algae as a soil conditioner is an organic, natural material and source of renewable energy. It retains water and essential nutrients to the soil which is required for the proper growth of a plant. It has been tried through various research for several years, algae is utilised as soil conditioner where its liquid preparation and powered extracts are used effectively on cereals crops due to which increase in crop yield, improved nutrient uptake, resistant to pest has been reported.

Blue green algae are simplest autotrophic plant having a high value as a soil conditioner because of its ability of building up food materials from in organic matters and its ability to photosynthesize food and fix atmospheric nitrogen shows its symbiotic relation in paddy fields. Their anti fungal activity makes them more suitable for use as bio fertilizer[14]. BGA synthesize and liberate auxin and amino compounds which stimulate the growth of plants, used particularly in rice crops[15]. A cyno bacteria an another algae species is used in paddy field as a major component and its ability to fix nitrogen and proves itself beneficial for plant and soil[2].

Giant Kelp (an algal species) is also used as a fertilizer with a combination of other fertilizer which provides plants a high value of nutrients they need. Kelp fertilizer comes in liquid, soluble powder and solid forms. This practice is in application in pacific coast of North America[16]. It provides all the major nutrients including 2.5 lbs of potassium which is a major plant nutrient.

BGA has also proved very effective for seed treatment as replacement to chemicals, used for the same by increasing the yield, weight and oil content and also inducing resistance to *Tikka* disease in ground nut plant[14]. Several studies shows

that algae is having a life circulation of about 10- 15 days, so can multiply and becomes double in a less time interval, which is beneficial for large scale production of algal fertilizer. As it is a biotic component so it does not cause any harm to environment, hence algae proves itself eco friendly. Dry algae also act as humus for the soil which helps in binding the soil and makes it more beneficial to use as bio fertilizer. Dry algae is an organic material so it can hold nutrient inside it and supply to plants by capillary action for a longer duration, mostly chemical fertilizer dissolve in water and settle down deep in earth due to which nutrient get unavailable to plants after a certain time period so algal fertilizer is having for this quality. It also increase the water holding capacity of soil and increase the inter molecular space between soil molecule due to which proper aeration is supplied to root system.

#### V. CONSTRAINT

Artificial or organic fertilizer can cause serious problems as they contaminate fresh water and marine eco system. The nutrient in fertilizer which nourish crops, plants etc can cause rapid growth of algae also known as algal bloom. Dying algae feeds to bacteria by which dissolved oxygen is consumed and results into death of fish and marine plants. Some of the algae species are harmful to human because of toxin produced by them[17]. Some of algal species produce toxin which cause death of fish, birds and mammals, which finally cause health problems to humans. Other algal species are not toxic but cause bad smell and destroy the fish taste grown in the same water. Mostly humans are affected by contaminated sea food[18].

Some major drawbacks of algae for being used as fertilizer are technical problem of developing algae on a large scale, also this fertilizer is not famous in farmers, people are not aware of it and lack of public support along with lack of governmental policies regarding algal fertilizers. Nutrient release from algae is slow and some of algal species release toxic products which is fatal for humans, practices have been done up to lab scale and trail basis so, more research is required to check the toxic products releasing from algae and biotechnological application are needed.

#### VI. CONCLUSION

In India, considerable progress has been made in the development of algae based bio fertilizer technology. It has also been demonstrated that this method can be utilized as a powerful means of enriching the soil fertility and increasing various crop yield. However the technology needs to be improved further for better exploitation under sustainable agriculture system. Technical training on the production and quality control to the producers can show a better sustainable growth of algal fertilizer. Also, organisational training to the extension workers and farmers can popularize the technology.

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