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A REVIEW PAPER ON BIO FERTILIZERS AND ORGANIC AGRICULTURE

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ABSTRACT

Bio fertilisers play an important role in worldwide food production because they provide rapid nutrition for plants, allowing them to develop more quickly and efficiently. While there have been negative effects associated with the excessive and imbalanced usage of these synthetic inputs. Furthermore, continuing to use conventional chemical fertilisers disturbs soil ecology, decreases soil fertility, has serious health effects, and pollutes ground water. Current soil management practices largely depend on inorganic chemical-based fertilizers, which pose a serious health and environmental danger. Chemical fertilizers, on the other hand, have a number of negative consequences, including pollution, global warming, soil microbial diversity, and so on. Furthermore, because of its microbial dispersion and role in the degradation of soil environmental sustainability, it influenced the dynamics of soil plants. The function of bio fertilizers in stimulating different growth and defence genes in signalling networks of cellular pathways, which leads to cellular responses and thus crop improvement, such as plant growth and productivity, nutrient profiles, plant defence and protective characteristics, has been highlighted in this review. The information gained from the literature reviewed here will enable us to acquire a better understanding of the physiological underpinnings of bio fertilizers, reducing the challenges associated with their usage.

KEYWORDS: *Agriculture, Bio Fertilizers, Plants, Soil, Sustainable Farming.*

1. INTRODUCTION:

Since their evolution, agriculture and agricultural resources have been the only livelihood of mankind. Most of the world's population is relying on food, food and other key products of agriculture (fibre, wood, gums and medicinal goods) to support a healthy lifestyle. In line with increasing population trends, researchers/agricultural scientists/agro-industries must create appropriate techniques of sustainable agriculture in order to fulfil the needs of the increasing population[1]. Any civic society's major objective is to control farming methods up to levels which may ban hunger demands enough.The traditional agricultural practises include food and feed production only at household level. Only families of farmers and their small village communities can use traditional methods. The progress of scientific technology can lead to a rise in the production per acre. Sustainable farming principles are not only a means of cultivating crops up to their maximum level, but ecological conservation also determines the success of sustainability in agriculture[2].The way farming is evolving nowadays is perplexing, since the focus is on the conservation of environmental resources and the agricultural system is only concerned with maximum agro-production. Agriculture involves the usage for enhancing crop output by different hormones, artificial fertilisers and other synthetic minerals. The impacts on soil and plant health are of Synthetic Chemicals and Minerals. Although output may rise with greater chemical use, the degradation of key minerals and other nutritional components occasionally acts as a barrier to higher production[3].

Sustainability in agriculture may be accomplished without jeopardising future generations' environmental resources and capacity to fulfil their own needs. Excess usage of chemicals causes favourable living circumstances to become less widespread, since residues that function as secondary pollutants might infiltrate the food chains and food webs and enter ultimately human beings. With the impact of health dangers, secondary pollutants can remain for a reasonably long time in the environment[4]. A new age of industrialisation may be opened up by the use of biofertilizers rather than chemicals in agriculture.Without degrading natural climate, biofertilizers might assist provide nutrients for agricultural plants. This section might be a welcoming approach to the creation and usage of biofertilizers for sustainable farming.

1.1 Biofertilizers:

Biofilters maintain a rich soil environment with a variety of micro- and macronutrients via nitrogen fixation, phosphate and polymerisation, release of plant growth regulating substances, antibiotics and soil biodegradation which improves nutrient intakes and increases tolerance for soil products [5]. Biofertilizers are neither chemical and organic fertilisers in that they do not give nutrients directly to crops and are relatively straightforward and cost-effective cultures of specially designed bacteria and fungus.Thus, at a time when agriculture faces a wide variety of environmental pressures and changes, bio-enrichment can tackle the problem of feeding a growing global population[6].

1.1.1 Characteristics Necessary for the Release of Bio fertilizer in the Market:

The usage of biofertilizers for increased crop output for farmers is one of the main limitations in the agriculture industry. While several biofertilizers are currently on the market, they are of different quantities and qualities depending on the manufacturing facility. A biofertilizer must have the following preconditional properties before release into the market.

1.1.1.1 Offer:

Bio fertilizers should be readily available on the market. Easy access minimises transportation costs and saves farmer's time.

1.1.1.2 Stability of the storage:

The formulations for bio fertilizers should be stable in various air conditions. With time length, the quality of wording should remain the same.

1.1.1.3 Effectiveness:

Bio fertilizers in minimum quantity should be required for their on-field application and should make the combination of nutrients necessary in crops efficient.

1.1.1.4 Solubility and action:

Formulations should be soluble in water as they are cost reduction and may be administered in wider field areas using the spray method.

Formulation should ensure that no adverse effects are caused to plant nutrients supplied immediately. It should be easy to use and should not affect the health of the farmer. For farmers at a reasonable cost, it should be accessible since it also influences the price of crops. It should be seasonal and available to farmers all year round.

1.1.2 Quality Control and Scale-Up:

One of the biggest obstacles for improved crop productivity is the availability of excellent biofertilizers on the market. Biofertilizer ratings vary, however, unit to unit and manner of action. The manufacturing unit must have the following criteria before the commercial production of biofertilizers:

- Determination of appropriate field design of the required inoculum.
- When production is economically understood and workable, planning should begin on facilities and organisation.
- Adequate personnel training in manufacturing and quality control technical elements.
- Provision of microbiological installations necessary.
- Uninterrupted provision of microbial consortia to support healthy strain lifecycle with maximal biomass production and access to necessary equipment.

1.1.3 Potential of Biofertilizers in crops production:

Bio fertilizers could be employed as a nutrient source or to improve soil microbiology by keeping fruit yield and quality and encouraging cheap production costs for nutritionally supplied plants[5]. Microorganisms attaching nitrogen plays a significant function in boosting production by transforming the atmospheric nitrogen into plant-usable organic forms. Rhizobia are linked symbiotically with legumes, and nitrogen fixation occurs in the root or stem nodules of the bacteria. Inoculation with rhizobium aids increase nodulation, plant development and generates 10-15 percent more grain production under cultivated conditions than non-inoculated crops.

The two main non-symbiotic N-fixing bacteria in non-leguminous cultivations are azotobacter and Azospirillum. These N-fixing bacteria may be rice plants that are free-living, or naturally. Azotobacter and Azospirillum can improve plant development and boost the yields of several key crops on various soils and climatic areas under proper conditions[7]. As Azotobacter has a range of metabolic activities, it plays an essential part in the natural nitrogen cycle. In order to synthesise and secrete substances such as thiamines and riboflavin, the nicotine acid, pantothenic acid, biotin, heteroxins, gibberellin and ammonia secretion in the rhizosphere in the presence of root exudates which can contribute to n modification, Azotobacter plays a significant role in nitrogen fixation[7].

Various soil bacteria and certain fungal species have the capacity to bring soil in soluble forms of insoluble phosphate by removing or lowering the phosphate pH and releasing accessible phosphate. PSB-produced organic acids solvent insoluble phosphates by reducing pH, cation chelating and phosphate competing in soil adsorption sites. Plant growth promoting bacteria (PGPB) represents a wide range of soil bacteria (for example, genus Azospirillum, Azotobacter, Bacillus, Pseudomonas) that play a major part in plant rhizosphere growing in conjunction with a host plant[8].

Promoting plant growth, improved yield, N intake and other components using PGPR inoculations that greatly encourage canola and sugar beet development, and increased stir and root growth. Plant growth promoters, such as Bacillus and Pseudomonas (PGPR) that are capable of producing indoleacetic acid (IAA) and gibberellins, are capable of having a positive impact on plant development and are thus utilised for farming as biofertilizers.Pseudomonas not only destroys organic nitrogen molecules, but also enhances the circulation of N and P in land. Field visual inspections showed that, despite unfavourable, very dry climatic circumstances, plant growing regulators led to strong development of greener and bigger leaves. PGPR inoculations that protect plants from soil-borne illnesses, mostly caused by pathogens, via the suppression of plant diseases-causing organisms.

1.1.4 Potential Of Bio fertilizers in Crops Production

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1.2 Nitrogen Fixation:

Nitrogen fixation, which makes nitrogen recycling and offers a key contribution to nitrogen homeostasis in the biosphere, is regarded as one of the major biological processes and an interested microbial activity on the earth's surface after photo synthesis. Fixation of organic nitrogen is crucial in the maintenance of soil fertility. Based on the quick growth and high degree of nitrogen fixation, Azotobacter are employed to research nitrogen fixing and plant inoculation. They are very oxygen tolerant whereas fiber-induced nitrogen and are related to nitrogenase breathing. They have breathing protection, hydrogenase absorption, and turn off nitrogenase enzyme defence against oxygen. It is found that Azotobacter chroococcum has hydrogenase absorption that metabolises hydrogen. Azotobacter may convert nitrogen into ammonia and the plants in turn, as illustrated in Figure 1.

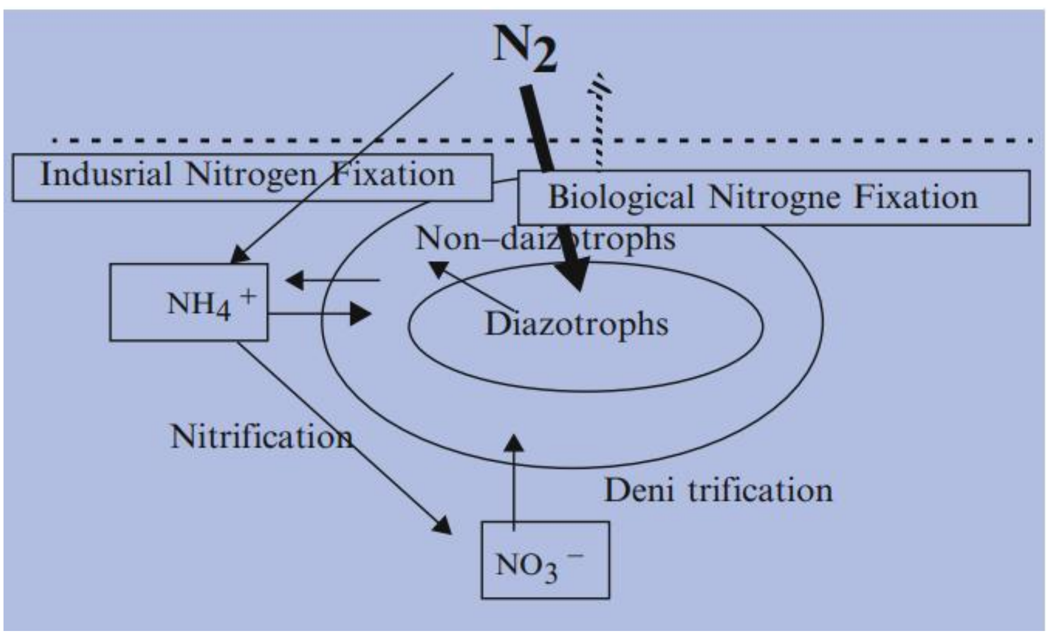

Figure 1: Nitrogen to Ammonia Cycle and Its Fixation by Diazotrophs with the Soil as Biofertilizers.

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1.3 Types of Biofertilizers:

Biofertilizers are live microbe formulae (useful bacteria and fungi) readily applied, improving soil and plant species quality and health by increasing the availability of nutrients to soil and plants. The microorganisms used in microbial biofertilization may be classified into two types, which are symbiotic, non-symbiotic, and blue-green. Bio fertilizers include, thus, symbiotically Rhizobium spp. nitrogen fixers symbiotically free, Algae bio fertilizers, phosphate solubility bacteria, Mycorrhizal and Biofertilizers, blue green algae, or BGA in combination with Azolla.Microbial fertilisers such as rhizobiums and phosphate solubilizes, (PSB), make the two necessary nutrients available to plants by their synergistic action extremely helpful to enhance nitrogen content (N) and phosphorus content (P). The plant growth promoting rheizobactéries (PGPRs) are the foundation of many marketable biofertilizers that lead to plant growth through several processes, among them the biological N2, increasing the availability of nutrients in the rhespheres, expanding the root area, enhancing the useful host symbiosis to provide sequestered iron by bacterial siderophores, and soluble phosphate.Few of them are discussed below.

1.3.1 Rhizobium Bio fertilizer:

In underdeveloped nations, the lack of substantial nutrients in food crops poses significant challenges. Technologies with more emphasis on using microbial consortium products, particularly plant growth-fostering rhizobacteria, are needed for the solution of these tough tasks in order to support sustainable crop development and to fulfil future food requirements. Rhizobium is an endosymbiont for the nitrogen fixation belonging to the Rhizobiaceae family. It infects plant roots and causes certain root nodules to develop. Root nodules microorganisms decrease molecular nitrogen in form of a plant system of ammonia for protein, vitamin and other essential nitrogen-contaminating compound synthesis.

1.3.2 Azotobacter Bio fertilizer:

Since Azotobacter is a no symbiont, it offers a wide variety of benefits for the crops. Azotobacter Azotobacter's connection with crop plants helps them maintain their healthy lifestyles and maximum output. Azotobacter belongs to the Azotobacteraceae family and is aerobic in nature. Several science papers propose the usage for the maximum crop output of Azotobacter in the field. The Azotobacter and associated strains are used to improve the dry matter of the plant and the synthesis of secondary metabolites.Sustainable farming practises might provide benefit for the important functional characteristics of the strains of Azotobacter, which include enhancing fertility of the soil and nitrogen fixation, boosting yield, promoting plant development, helping to withstand drought and anti-pathogenic plants.

1.3.3 Azospirillum Bio fertilizer:

Azospirillum is another bio fertilizer category that supports the growth of diverse biochemical reactions needed in the creation of food. In general, Azospirillum is a key member of the Rhodospirillal order and has occasionally been closely connected with grasses, in particular maize and rice. Nitrogen fixation, secretion of special fungicides and phytohormones are connected with their connection. In particular, indole-3-acetic acid (IAA), salicylic acid, and auxins are produced with a specific ability of Azospirillum. Azospirillum protects plants against biotic and abiotic stress and increases moisture and nutrient intake and boosts total output.

1.3.4 Phosphate-Solubilizing Microbe Bio fertilizer:

Phosphorus has its own relevance among macronutrients as it controls signals, protein synthesis, respiration and fixation of nitrogen in plants. Phosphorus is an insoluble element in soil; hence plants do not use it. It needs to be transformed from a complicated bound to a free form for frequent ingestion. Some bacterial strains can reduce phosphorus into the simplest form, so that plant roots are readily absorbed. Phosphate-solubilizing bacteria are, however, widespread in nature and may vary according to the soil types and the area from where they are isolated.

1.3.5 Arbuscular Mycorrhizal Biofertilizer:

In their many stages of growth and development, natural resources are continually faced by abiotic stress. Under stressful conditions, plants begin to produce particular categories of secondary metabolites in order to counteract reactive oxygen overproduction. The synthesis of particular components allows the plant to survive under harder conditions to a certain extent. One of the most essential aspects in maintaining good crop plant life is the symbiotic connection. AMF are a crucial symbol for the effective absorption of nutrients and diverse enzyme responses of the majority of plants.

2 DISCUSSION

Consumer views about the usage of bio fertilisers and food produced acceptability and manufacturing safety for human well-being are quite important. The consequences of chemical fertilisers on the public, the land and the ecosystem are deteriorating. However, development, marketing and their technique of application are under the authority of major businesses and genetic committees. Bio fertilize agro-industrial issues can be solved in a very specific manner.Chemical fertilisers in contemporary farming have decreased soil fertility, rendering it inadequate for the cultivation of crops.Furthermore, these inputs' extensive usage has resulted in serious health and environmental threats such as soil erosion, pollution of the water, pesticide poisoning, decreasing groundwater table, water logging and biodiversity depletion. Bio fertilisers naturally activate the soil's inexpensive, efficient and environmental friendly microorganisms and, as a result, promote plant growth and restore the natural fertility of the soil from drought or soil disease.Further research and development are needed to understand the mechures to act for different biofertilizer and find more competent rhizobacterial strains and carrier materials to make agriculture more sustainable and economical. The success of biofertilizer technology requires further research and development.Farmers should be instructed on the environmental and other major favourable impacts on the farming system of biofertilizers to make them more popular among farmers.

3 CONCLUSION

For the economic prosperity of a country, a thorough understanding of biofertilizer production and use is needed. In order for farmers to be aware of their core concept of sustainability, design, manner of production, use and storage conditions are crucial. In agriculture, sustainability is very useful for eliminating the real agricultural difficulties associated with crop production. In addition, the design of their agriculture system based on biotechnological and environmental issues of biofertilizers requires the training of marginal farmers in underdeveloped nations. This chapter provides a comprehensive examination of biofertilizer effectiveness in achieving sustainable agriculture.

Biofertilizers are able to address the difficulties of agro-industry and provide new chances for the improvement of farmers in agriculture, businesses, academics and other key government sectors in rural regions.Although bio fertilisers are able to significantly boost agricultural land productivity, the most decisive element in the increase in productivity is the integrated approach to the determination of the best-favored plant microbe interaction. The emerging technology can play a crucial part in the investigation of the most advantageous plant-microorganism interaction utilising a potent molecular biotechnology tool. The success of biofertilizers is therefore dependent upon innovations of novel tactics linked to functions and the appropriate administration of the many helpful bacteria to the field using sophisticated and better procedures. A major step in achieving long-term success in this growing sector is extensive study on generating effective, temperature-tailoring strains. The most essential and hard aspect of the research is to examine the real bio-fertilizer mechanism for their efficiency in sustainable development exploration, along with the discovery of numerous bio-fertilizer strains and their characteristics.

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