TO EVALUATE THE EFFECT OF BIOFERTILIZER ON PLANT GROWTH AND SOIL HEALTH

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Abstract

Biofertilizer has been proven successful technology in many developed countries. The use of Biofertilizer improves soil fertility by fixing atmospheric nitrogen, solubilizing insoluble phosphates, producing plant growth-promoting substances in the soil and promoting nodulation ability, which increases the yield by 20-80%. The term biofertilizer or microbial inoculants/fertilizer is defined as a preparation containing live or latent cells of efficient strains capable of nitrogen fixation, phosphate solubilization which are used for application of seed, soil with the objective of increasing the numbers of such microorganisms and accelerate certain microbial process to enhance the degree of the availability of nutrients to plants [1]. Increasing cost of chemical fertilizers is unaffordable by small and marginal farmers. There is found depletion of soil fertility due to widening gap between nutrient removal and supplies. By considering the threat to sustainable agriculture by the use of chemical fertilizers and human activity there is growing concern about environmental hazard management. In developing countries exploitation of bio- inoculants is hampered by several factors [13].

Long term use of organic fertilizers is economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over chemical fertilizers. The chapter provide overview knowledge about different bacterial, fungal and algal biofertilizer, its association with plants and transformations of nutrients in soil.

Keyword: [Bio fertilizer, Microorganisms, Biological Nitrogen Fixation, eco-friendly]

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INTRODUCTION:

The excess application of chemical fertilizer will lead to higher chances of minerals to be lost and pollute the environment. Over usage of chemical fertilizers and its subsequent deterioration of soil has been realized these days [11]. Biofertilizers likely called as bio- inoculants as they are the preparations containing living or latent cells of microorganisms that facilitate crop plants uptake of nutrients by their interactions with the rhizosphere once applied through seed or soil. It accelerates bound microorganism processes within the soil that augment the extent of convenience of nutrients in a very type simply assimilated by plants [4].

The cultured microorganisms packed in some carrier material for easy application in the field are called biofertilizers. Bio-fertilizers are living microorganisms of bacterial, fungal and algae origin. Biofertilizer can provide an economically viable support to small and marginal farmers for realizing the ultimate goal of increasing productivity.

Bacterial bio-fertilizer contains soil microorganisms such as bacteria, algae or fungi that increase the uptake of mineral nutrients in the plant. Biological control using microbes is an effective and environmentally friendly strategy for controlling soil-borne fungal pathogens and promoting plant growth [5].

To increase production and productivity, maintain soil health, reduce nutrient losses, improve soil environment and minimize energy consumption, it is necessary to use

bio-fertilizers. Bio-fertilizers also help in fixing atmospheric nitrogen, dissolve soil phosphorus and stimulate plant growth through synthesis of growth promoting substances.

In the soil with poor agricultural activity, the use of PGPR assumes significant importance because they adapt to diverse environmental conditions, like drought stress [2]. Although the farmers are now awaking about the importance of biofertilizer uses but still there is unawareness amongst the farmers about the facts regarding utilization, storage and handling of the product. Thus, biofertilizer developed during present investigation could prove to be ecofriendly, cost effective and could be effectively used in agriculture practices for sustainable agriculture approach.

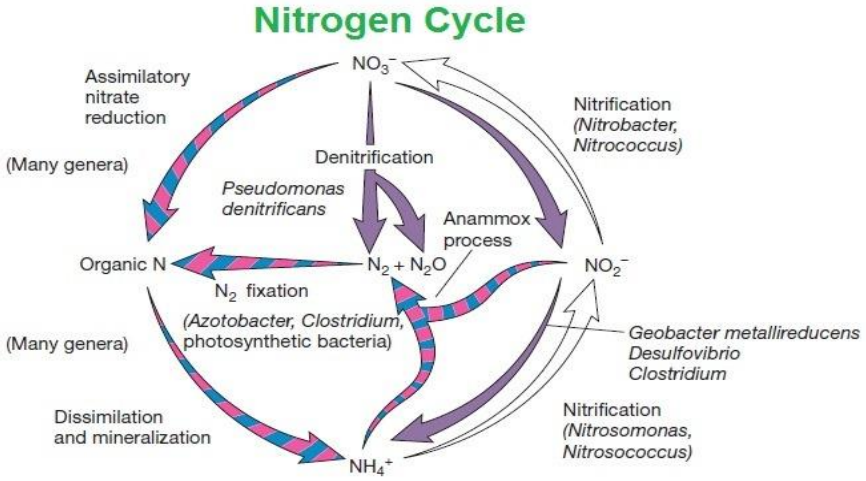
In the present research work, the attempt was made to develop effective bacterial based fertilizer.

Importance of soil microbes in nutrient transformations

It is well established fact that soil microbes have versatile enzyme systems hence perform various nutrient transformations in soil which is very important for maintaining soil equilibrium and its health [6]. Among the nutrient transformations nitrogen and phosphors transformations forms significant importance, since they are the major plant nutrients derived from the soil.

Nitrogen transformations

Nitrogen cycle involves of transformations of nitrogen by particular group of soil microbes into organic, inorganic and volatile forms. In addition, a small part of the large reservoir of N_2 in the atmosphere is converted to organic compounds by certain free living microorganism or by plant microbe association that makes the element available to plant growth [7]. The atmospheric nitrogen constitutes about 78% in gaseous form which cannot be utilized by plant and other living organisms which is referred to as biological nitrogen fixation [9]. The details of nitrogen transformations occurring in soil with the role of microbes involved has been depicted below:



Biological nitrogen fixation

Biological nitrogen fixation is a component of nitrogen cycle which involves fixing up of atmospheric nitrogen by particular soil microorganisms. Nitrogen fixing ability has been restricted only to certain bacteria and few actinomycetes which belong to various groups and they are referred to as diazotrophs [10]. Diazotrophic microbes are ubiquitous to soil and are classified according to mode of nitrogen fixation to plants.

S. No.	Groups	Examples
1.	Free-living	*Azotobacter, Beijerinckia, Clostridium, Klebsiella, Anabaena, Nostoc*
2.	Symbiotic	*Rhizobium, Frankia, Anabaena azollae*
3.	Associative Symbiotic	*Azospirillum*

Groups of important diazotrophic organisms according to mode of nitrogen fixation

MATERIAL AND METHOD:

Sampling sites and collection of soil samples

As the study aimed at isolation of Pseudomonas species for the preparation of the biofertilizer and related bioassays, on the basis of thorough analysis of literature review cultivated lands with growing crops were selected, for probable isolation of *Pseudomonas* species. While sampling, undamaged roots and nearby adhered soil samples were collected from the plant's rhizospheric region.

Isolation of Pseudomonas species

Collected soil samples were processed further for serial dilution by suspending its 1gram (g) into 100 milliliter (ml) sterile distilled water and kept on rotating shaker for 24 hours (hr). Mixing by rotation ensured release of soil from roots and also the associated bacterial population in water. One ml of the sample was further diluted in 10^{-1} to 10^{-6} times and 100 micro liter (µl) of the sample was spread plated on already prepared King's medium B (KMB) agar plate (selective media for *Pseudomonas* species). Plates were incubated at 29 degree celsius (ºC) for 48hr for the development of the colonies.

Characterization of isolates

Preliminary identified fluorescent *Pseudomonas* species confirmed for their morphological, microbiological and biochemical characters by following standards of Bergey's Manual of Systematic Bacteriology.

Method of Preparation of Bio- fertilizer by using isolated Pseudomonas bacteria

By thorough analysis of the isolated Pseudomonas bacteria through microbiological, biochemical and molecular profiling as well as for its plant growth promotional activity, the said bacterium finally selected for biofertilizer preparation which is called as bacterial fertilizer or biofertilizer. Freshly grown Pseudomonas bacteria culture were inoculated in 500ml conical flask containing Nutrient broth amended with 2% glycerol. This flask was kept on rotary shaker for 48 hrs and then used as biofertilizer.

Today's agriculture demand is to feed the growing population without disquieting the natural resources of ecosystem. The overuse of pesticides and chemical fertilizers causes toxic impact on production potential and ultimately on consumer of agricultural products. It is also associated with environmental and health problems. Due to decline in soil fertility, the overall agriculture production has gone down which put a questions on the profitability and sustainability of the agriculture system. On the other hand, biofertilizer can be used to **s**timulate plant growth, activate the soil biologically, restore natural soil fertility**,** build up soil fertility in the long term, cost effective, i.e. reduces the costs toward fertilizers use especially regarding nitrogen and phosphorus, supplement to fertilizers. They are eco-friendly and cause no damage to the environment.

CONCLUSION

In current agriculture practices, chemical fertilizers have reduced the fertility of soil, making it unsuited for raising crop plants. Additionally, the excessive use of these inputs has also led to severe health and environmental hazards such as soil erosion, water contamination, pesticide poisoning, falling ground water table, water logging and depletion of biodiversity.

Biofertilizers spontaneously activates the microorganisms found in the soil in an effective and eco-friendly way, thereby gaining more importance for utilization in crop production, restoring the soils fertility and protecting it against drought, soil diseases and thus stimulate plant growth.

Biofertilizers lead to soil enrichment and are suitable with long-term sustainability. Further, they pose no danger to the environment and can be substituted with chemical fertilizers. The

application of bio-fertilizers can minimize the use of chemical fertilizers, decreasing environmental hazards, enhance soil structure and promote agriculture. Biofertilizers are cheaper and remarkable in affecting the yield of cereal crops. Bio-fertilizers being important components of organic farming play a key role in maintaining long term soil fertility and sustainability by fixing insoluble P in the soil into forms available to plants, thus increasing their effectiveness and availability.

The beneficial bacterias in biofertilizers are Azotobacter, Azospirillium, Pseudomonas Rhizobium, Mycorrhizae which are very essential in crop production. Biofertilizer can also make plant resistant to unfavorable environmental stresses.

Products of biological origin can be advantageously blended to replace a part of the energy intensive inputs. The main aim of agriculture is to produce the sufficient amount of food for the growing population of the country. It is in this context, biofertilizer can provide to the small and marginal farmers an economically viable level for realizing the ultimate goal of increasing productivity. These microbes siphon out appreciable amount of nitrogen from the atmospheric reservoir, solubilize phosphorous and enrich the soil with the important but scarce nutrient. The crop-microbial-soil ecosystem can, therefore, be energized in sustainable agriculture with considerable ecological stability and environmental quality.

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