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Microorganisms as Novel Source of Bio-fertilizers

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ABSTRACT

Bio-fertilizers are constituents of microbial cells that colonizes rhizosphere of the plants to improve nutrients uptake by increasing the rate of mineralization of insoluble nutrients in the soil through numerous natural process such as nitrogen fixation, phosphorous fixation etc. and sustain the environment for future generations.

Key words: Bio-fertilizers, Microorganism, Nutrients

INTRODUCTION

The present world population is of about 7.2 billion is expected to cross 9.6 billion by the end of year 2050. In order to provide food to all by that times, the annual production of cereals needs a jump of about 50%, i.e., from 2.1 billion tons per year to ~3 billion tons per year. This puts enormous pressure on agriculture sector to achieve the food security. But such a quantum leap in food production can be achieved either by bringing more and more land under cultivation or by enhancing the productivity of cultivable land available. The first option remains a distant dream in the light of limited land and growing population. The option of increasing soil fertility and agricultural productivity with the help of better eco-friendly management tools, promises a successful food security.

Biofertilizer is a substance containing live microorganisms which exhibit beneficial properties toward plant growth and development. Various mechanisms are used by microbial strains in order to enhance nutrient uptake, improve soil fertility and increase crop yields such as nitrogen fixation, potassium and phosphorus solubilization, excretion of phytohormones, production of substances suppressing phytopathogens, guarding plants from abiotic and biotic stresses and detoxification of belowground pollutants. Taking into consideration growing consumption requirements on Earth and hazards arising from the excessive use of chemical fertilizers and pesticides, bio fertilizers are thought to be a promising and non-toxic alternative to synthetic agro-chemicals, including fungal control and minimization of my cotoxins contamination. The implementation of microbial inoculants is considered to overcome the shortcomings associated with chemical-based farming techniques, therefore research into widespread use of bio fertilizers is one of the mainstream in scientific work for the development of sustainable agriculture.(1,2)

The current agricultural practices are heavily dependent on the application of synthetic fertilizers and pesticides, intensive tillage, and over irrigation, which have undoubtedly helped many developing countries to meet the food requirement of their people; nevertheless raised environmental and health problems, which include deterioration of soil fertility, overuse of land and water resources, polluted environment, and increased cost of agricultural production. A big question before the present day agriculture is to enhance the agricultural production to meet the present and future food requirements of the population within the available limited resources, without deteriorating the environmental quality. The sustainable agriculture practices can fulfill the growing need of food as well as environmental quality.

MICROORGANISMS AND ECO FRIENDLY FARMING

The present philosophy of sustainable agriculture includes eco-friendly, low-cost farming with the help of native microorganisms. Agriculture could be improved and enhanced by the use of variety of microorganisms. These organisms can contribute in a number of ways. The main application is in the form of biofertilizers and green manure. They have been widely used as bio control agents. Some of the secretary products act as elicitor molecules. They are also symbionts with the eukaryotic plants which could be an end ophytic or an exophytic association. These mainly help in the procurement of basic elements like nitrogen, carbon, sulphur, phosphorus etc.

Apart from the application of microorganism in the fields and their symbiotic association, the recent budding technology is the genetic manipulation of eukaryotic plants by introducing the prokaryotic genes to them to improve their photosynthetic rates and ultimately their production.

Biofertilizers being ecofriendly could support the sustainable development and contribute in enhancing the production. They not only help to maintain the natural soil habitat, but also improve the fertility. Soil and crop management practises such as crop rotation, soil fertility restoration, bio control of plant diseases etc. used adequately can add up for improving the production rate along with the bio fertilizer. It also emphasizes that the farmers should work with natural processes to conserve resource such as soil and water, whilst minimizing the cost of agricultural production and waste generation that adversely affects the environment quality (5,6).

Such sustainable agricultural management practices will make the agro-ecosystem more resilient, self-regulating and also maintain the productivity and profitability. The microbial populations which could be used as a potential fertilizer and as a bio control may contain a specific population or a combination of two or more organism. This may consist of plant growth promoting Rhizobacteria, cyanobacteria, Actinomycetes, soil toxicant degrading microbes, plant disease suppressive bacteria and fungi and other useful microbes. Based upon the source of utilization they can be categorized as- Nitrogen fixers, Sulphur solubilizers, Phosphate mobilizers, Phosphorus solubilizers, Plant growth promoters etc.

BIOFERTILIZERS TYPES.

a) **Rhizobium**: Rhizobium is a nitrogen fixing bacteria that colonizes the root nodules of legumous plants and is an effective bio fertilizers. They are referred as cross inoculation group for being specific to form root nodules in legumous plants and has seven genera [7, 8]. For all legumous plants it is applied as seed inoculants [9]

b) **Azotobacter:** Another nitrogen fixing bacteria inoculants that produces ample slime which aids in soil accretion e.g. A. chroococcum.

c) **Azospirillum:** Nitrogen fixing bacteria that colonizes the non-leguminous graminaceous plants rhizosphere and intercellular spaces of root cortex e.g. Azospirillumlipoferum, A. brasilense, A. amazonense. Besides these have the ability to reduce nitrate, denitrify etc [10].Azospirillum is inoculated through seed, seedling root tip and soil application methods.

d) **Cyanobacteria:** Free-living /symbiotic cyanobacteria is used as a bio fertilizers for rice

CYANOBACTERIA AS GREEN TECHNOLOGY AND BIOFIRTILIZERS

Cyanobacteria -Increment in population has directly and indirectly dependent on the demand for contamination-free healthy food. World Health Organization has estimated an increase of 50% of global food production by 2029. “Green Revolution” practices are also working for the increases in productivity of agriculture and reduce the risk of chemical-based fertilizers on human health as well as the environment.(3,4). Thus, ‘green technology’ has been used by researchers for making eco-friendly environment by the exploitation of microbes. Green technology discusses several aspects of the use of cyanobacteria to improve crop productivity and soil fertility. Cyanobacteria can degrade a wide range of pollutants and perform different roles in the soil ecosystem to sustain soil fertility .Cyanobacteria are emerging microorganism for sustainable agricultural development.

Diazotrophes are cyanobacteria useful for the generation of eco-friendly biofertilizers which are easily available and less costly. They can control the nitrogen deficiency in plants, improve the aeration of soil, water holding capacity and add vitamin B12. The most efficient nitrogen-fixing cyanobacteria are Nostoc, Anabaena variabilis, Aulosirafertilisima, Calothrix sp., Tolypothrix sp., and Scytonema sp. are present in the rice crop cultivation area. Some metabolites such as cyanotoxins are reported to have toxic effects, but they can be exploited for their allelochemical nature and can be introduced in agricultural fields as pesticides i.e., algicides, fungicides, weedicides, and herbicides.

The Cyanobacteria are one of the most primitive photosynthetic prokaryote with minimum nutritional requirements for growth. Cyanobacteria are a diverse group of prokaryotic photosynthetic micro-organisms that can grow rapidly due to their simple structure. They are microscopic unicellular organisms capable to convert solar energy to chemical energy via photosyn thesis. It is a group, of potentially rich source of a vast array of chemical products with applications in the feed, food, nutritional, and even in agriculture industries. A great variety of secondary (biologically active) metabolites, which cannot be found in other organisms.

CONCLUSION

Sustainability considerations mandate that alternatives to nitrogen fertilizers must be urgently sought. These examples are only a few of the possible applications of cyanobacteria for economic development and their utilization is among the several challenges for the next millennium.

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