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Plant probiotics a new tool to increase yield, improve quality and reduce cost

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ABSTRACT

The paper presents plant probiotics and its benefits. The plant probiotics. Improves soil fertility by nitrogen fixation, nutrient retention and its delivery, decomposition of organic matter. The major benefits of plant probiotics is to reduce use of pesticides for healthy plans and increase yield. The various benefits have been narrated in detail in this paper. Probiotics are living microorganisms which when administered in adequate amount confer a health benefit of the host. This term is commonly used for bacteria such as lactobacillus, bifidobacterium etc. These organisms pass through the gastrointestinal tract of animals and human and might prevent or even cure diarrhea.

Keywords: *Soil fertility, Probiotics, bacteria, gastrointestinal and diarrhea.*

1. Introduction

Recently the term plant probiotics has been used to describe plant associated microorganisms which enhance the growth of the host plant when applied in adequate amount .These probiotics play an important role in various plant activities. Many of these plant probiotics help in phosphorous soluibalization. Some of these microbes has the ability to convert insoluble form of phosphorous into soluble. Uptake of p is an important character for plant growth promoting bacteria which helps to increase plant yield. Examples of such p-soluibalizing bacteria are pseudomonas, bacillus, rhizobium, micrococcus, achromobacter, erwinia, streptomyces acinetobacter, and agrobacterium etc .Plant probiotics gives various benefits to plants such as nitrogen fixation, improvement of soil, fertility, nutrient retention and delivery, decomposition of organic matter, minimization of use of pesticides for the production of healthy plants and increase of yield. Plant probiotics works as enemy of plant pathogens hence it works as friend of plant [1]. For ex.rhizobium inhibits the growth of pathogenic fungi such as aspergillus niger, fusarium oxysporium and affects on the yield of crop plants. Some probiotics carry out competitive inhibition of plant pathogens The microbes acts as a buffer in the soil for minerals that are presenting high concentration. Beneficial microorganisms provide and process nitrogen both by nitrogen fixation from air and by cycling higher (not usable) ammonium nitrogen to usable nitrates. Beneficial microbes soluibalizes phosphates in the soil thereby increasing P value that is available to plants and trees [2].

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2. Probiotics: as a tool for providing and recycling carbon

Carbon cycle is heavily dependent on microbial communities that fix atmospheric carbon promote plant growth and degrade or transform material in the environment (Fig.1). Large amount of carbon are current locked in high altitude permafrost, grassland soils, tropical forests and other ecosystems. Microbes play key role in determining the longevity and stability of this carbon which would release in the atmosphere

as green house gas (GHG) yet in many cases these microbially mediated processes are less predicted thus limiting their capability. Decomposition of organic carbon

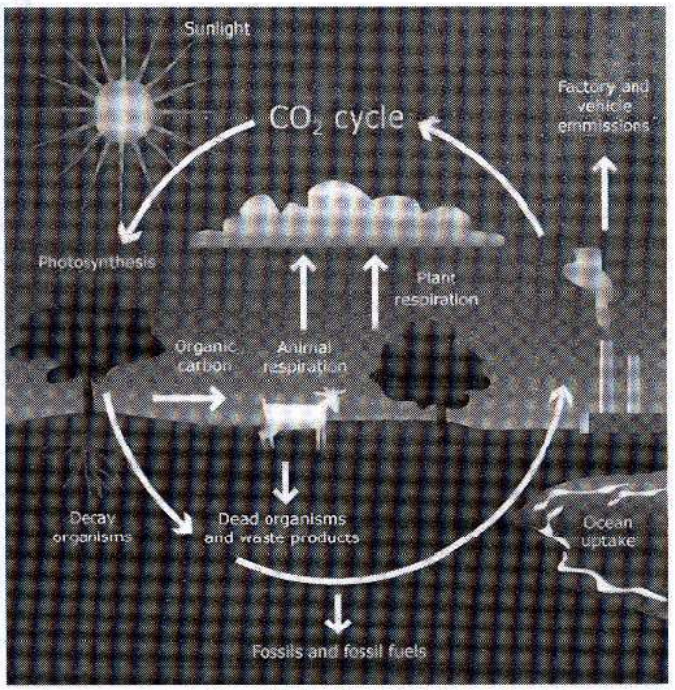

Fig. 1. Carbon Cycle

in soil is driven primarily by the activities of bacteria and fungi only 10-15 % of soil carbon flux is decomposed by the action of fauna. The vast majority of soil microorganisms are heterophytes that rely on organic matter for energy and nutrients among them some use fresh carbon substrates while some derive their energy from older, more recalcitrant forms of organic carbon [3].

The carbon cycle is great natural recycler of carbon atoms. The same carbon atoms are taken up by our body through various molecules. Thus the same carbon atoms can be recycled for millennia.

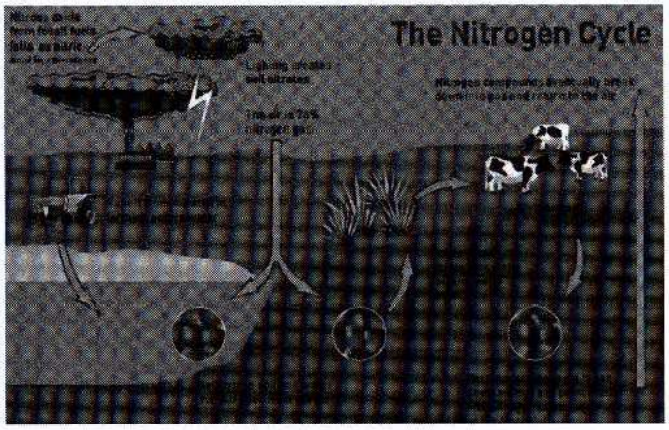

Fig. 2. Nitrogen Cycle

3. Probiotic: as a tool Nutrient retention and delivery

Soil microbes fix nutrients in the soil as well as atmosphere into their cell bodies and produces sticky biofilm. This

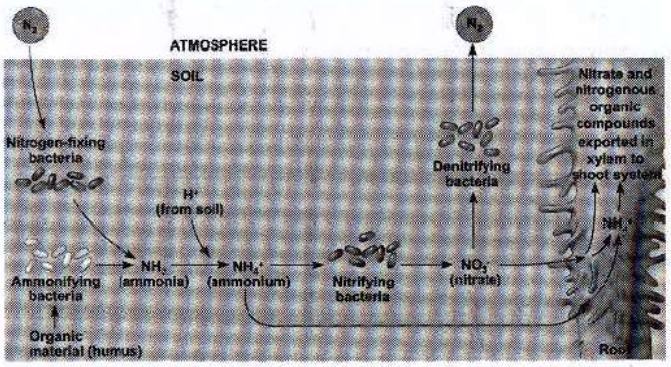

Fig. 3. Nitrogen biological fixation

helps to retain and maintain water and soil nutrients in the rhizosphere of plant. Microorganisms in the rhizosphere travels in the plants pares through conducting tissues and provide essential nutrients to the plants. It was found that trees growing in nutritionally poor forest soil may get proper nourishing after cultivation beneficial microorganisms to that rhizospheres. These microbes are efficient at turning inorganic minerals into nutrients in the utilizable forms for tree. Beneficial microbes convert complex carbon forms and nutrients into utilizable forms for plants trees and turfs. Microbes help to build up soil organic matter and retain water and nutrients potential for an increase in transfer to the wider environment.

The phosphorous which is an essential element for the growth of plant is not available in the utilizable form for the plant This process is called mobilization which describes the initial separation of p molecules from their sources via soluibalization or detachment. It operates at the soil profile scale and involves physical, geochemical and biological processes. Delivery of P from the point of mobilization to surface waters is complex and dependent on hydrology and may include surface and subsurface pathway [4, 5].

4. Probiotics: As a tool for nitrogen fixing and cycling

Beneficial Microbes provide and process nitrogen through both nitrogen fixation from air and by cycling higher ammonium nitrogen which is not usable to nitrates that is usable form. Nitrogen is an essential element for all living

forms. Nitrogen is chief ingradient in plants root zones of soil. Nitrogen fixing organisms are generally active in root exudates, exhibits higher nitrogen fixing ability in the soil.Biological fixation of atmospheric nitrogen can be estimated at about 175 million metric tons per year or about 70% of all nitrogen fixed on the earth per year. Remaining is carried out by some microorganisms, autotrophs, heterotrophs, free fixers etc. The elemental nitrogen(N_2) in atmosphere can not be utilized by plants which is being transformed by microorganisms. This process is called nitrogen fixation (Fig.3).This transformation of N_2 by microbes is mediated through symbiotic relationship with vascular plants., symbiosis between cyanobacteria and fungi or plants ,free living heteroprophic or autotrophic bacteria that are associated with soil or detritus and abiotic reactions occur without microbes in the atmospheric association with lighting [1, 6].

5. Probiotics: As a tool for phosphate cycling and recovery

Phosphorous is the second most important and limiting macronutrient for plant growth. P makes up about 0.2% of plant dry weight. It is a component of the key macromolecules such as DNA, RNA, phospholipids and ATP in the cell .P is one of the important constituents in the process of photosynthesis, nutrient transport and energy transfer. Beneficial microbes soluibalize phosphate in the soil thereby increasing the p values available to plants and trees. Therefore adequate p nutrition is essential for proper growth and yield of any crops. In soil the p exists in the forms such as solution, organic, inorganic and microbial biomass. Organic and inorganic p comes from the organic sources such as plant residues, manures and microbial tissues. Inorganic soil p contains apetite minerals, complexes of all iron, aluminium and calcium phosphates. A large portion of inorganic phosphates applied to soil as chemical fertilizer is rapidly immobilized soon after their application and becomes unavailable to plants .To overcome this problem farmers are asked to apply several fold excess p than necessity. This adversely affects both the environment and economy. Therefore the release of insoluible and fixed forms of p is an important aspect of increasing soil p availability and production of crops. This soluibalization of p is carried out by a number of organisms in the soil [7].

Fig. 4. Pest attack and pestisides spray

6. Probiotics: As a tool for control of pests and diseases

Two species competing for the same resources cannot stably co exists if other ecological factors are constant. Bacteria and fungi compete for the same resources .Bacteria divide much faster than fungi. and can compete them for limited sources. Pests attacks healthy plants. Pesticides weakens the plants. Weakened plants open the door to pests and diseases. Hence pesticides precipitates pest attacks and disease and disease susceptibility and thus they induce a cycle of further pesticide use (Fig.4). The more poison we apply, the more disease and pests we get. This problem can be solved by using synthetic pesticides with ecofriendly biopesticides. The infestetation of pests can be controlled by using bacteria by producing biopesticides. Many species of microbes such as bacillus tricoderma, streptomyces are able to destroy pests and protect the plant from pests and disease. Some nematodes feed on fungi and bacteria and are harmless to plants. These can be used as bio control agent [8].

7. Probiotics : As a tool for weed control

Weeds are just the plants that are growing where they are not wanted. It is any plant or vegetation interfering with the objective of the people. Microbial weed control represents an innovative means to manage troublesome weeds and utilize the naturally occurring biological herbicides produced by soil microorganisms. These compounds kill the growth of weeds so that beneficial plant species can gain competitive advantage. The vast diversity of microbes is still undiscovered and the potential discovery and characterization of these microbial compounds represents an opportunity to compete with chemical herbicide.

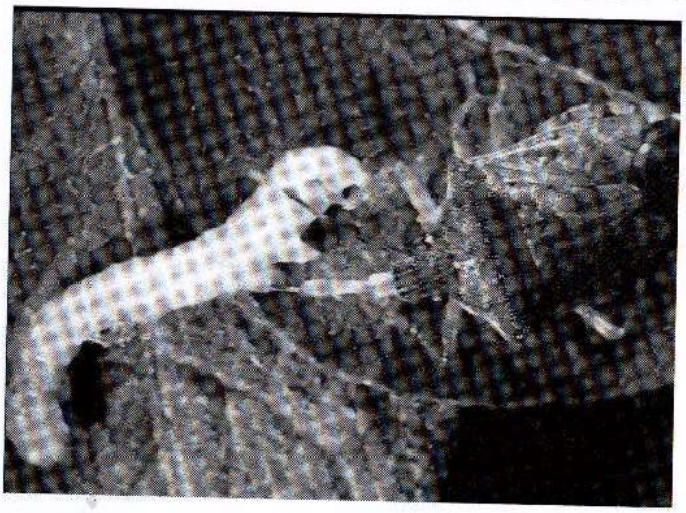

Fig. 5. Bio - control Weed Management

Moreover it can reduce the soil erosion caused by frequent tillage for weed control. Weeds affect the productivity of the crops. Effective and cost effective weed controls are not available for many weeds. Use of plant probiotics is an alternative way to slow the spread of these weeds using natural enemies (Fig.5). The development of biocontrol agent would minimize the need of chemical herbicide and provide greater options for weed management. The majority of biological herbicides developed to date are mycoherbicides [9].

8. Probiotics: As a tool for higher quality and yield

Certain soil bacteria that interact specifically with plant roots in the rhizosphere have the potential to directly increase plant growth . They do this by releasing phytoharmones fixing N_2 in the rhizosphere soluibalising nutrients like phosphorates, promoting mycorrhizal function in roots. Beneficial soil bacteria are usually referred to as PGPR (plant growth promoting rhizobacteria.) For ex. Gibberlins are a group of phytoharmones that influence many developmental processes in higher plants, bacillus cereus significantly promoted the growth of red pepper seedlings. Applications pf PSB has been found to increase yield and quality of many crops such as rice wheat maize, potato and beans [10, 11].

9. Conclution:

Plant probiotics gives various benefits to plants such as nitrogen fixation, improvement of soil, fertility, nutrient retention and delivery, decomposition of organic matter, minimization of use of pesticides for the production of healthy plants and increase of yield. Plant probiotics works as enemy of plant pathogens, hence it works as friend of plant.

10. References :

[1] Islam and Hossain (2012), Plant probiotics in phosphorous nutrition in crop, with special reference to rice.

[2] Lee and pion, (2005) gibberlins producing rhizobacteria increase endogenous gibberlins content and promote growth of red paper, *The Journal of Microbiology,* 510-515.

[3] Pawar A.V. , Pawar P.R. Bhosle M.A.(2014) Effect of Rhizobium on seed germination and growth of plants, *Journal of Academia and Industrial Research (JAIR)* Vol. 3.

[4] Michel Martin,(2003) soil ecology and soil food web,journal of soil secrets.

[5] Mishra, Upadhyay & Nautiyal (2013) Unrevealing the beneficial role of microbial contributors in reducing the allelopathic effects of weeds, *Journal of Application of Microbial Biotechnology.*

[6] Soccol C.R. Sauza L.P. Spier M.R.(2010), Potential of probiotics: A review , *Journal of food & Biotechnology* 48(4) 413-434.

[7] Das and Dkhar,(2011), American and Eurasian journal of Agric. And Environ. Sci.,10(2),140-150.

[8] Shridhar (2012)Review: Nitrogen fixing microorganisms, *International Journal of Microbiology Research* 3(1) 46-52.

[9] Muhammad Tariq,and Qurban Ali, Anwar Khanet.al.(2014)Yield Potential study of Capsicum annum L under the application of PGPR, *International Journal of Advances in Life Sciences.*

[10] Plant Physiology, Pande and Sinha 4th edition 362-374.

[11] Carney and Matson (2005), Plant communities, soil Microorganism and soil carbon cycling, *Journal of Environmental Science,* 8, 928-940.