ROLE OF MICROORGANISMS IN ENVIRONMENT MANAGEMENT AND PLANT NUTRITION

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Received: June 20, 2018 Accepted: August 01, 2018

ABSTRACT *Soil microorganisms provide a crucial role in nourishing and protecting plants. They also play an important role in providing air , soil and water services that are totally severe to human survival.Acknowleding this relation allows better nutrient management decisions.The management of soil fertility through biofertilizers is a vital constituent of sustainable agriculture. The crops-microbial-soil ecosystem canbe vitaliser in sustainable agriculture with significant ecological stability and environmental quality.*

Keywords: *microorganism, biofertilizer and sustainable agriculture.*

1.Introduction

In India green revolution has exhibited a bound in agricultural production with the beginning of high yielding varities of different crops and by following concerted practices with the use of fertilizers, pesticides and other synthetic process. The severe use of these process has not only exaggerated the human being but also polluted the soil, water and environment causing their slow degradation. Requirement would not only to assemble the agricultural production but also increase further with the raise in the country's population in a sustainable way. This is realized by scientist that green revolution food has reach a high level of success.

Organic agriculture is a expedient substituent because it provide the soil , strengthens the natural reserves base and sustains biological production at level to balanced that carrying ability of the managed agro eco-system. In this manner export market can also be rap by group action in organic farming. Food production has to grow steadily in India. Abruptly interchanging over to organic farming is not expedient. The phase will be set in due course for a equal change to farming without causing any decline in productivity of crops. Products of biological origin canbe favourably blended to replace a part of the energy concentrate inputs. In this background, biofertilizers can provide to the small and borderline farmer on economically feasible level for realizing the terminal goal of increasing productivity.

The organic and inorganic material of natural or artificial origin which are mixed soil to provide particular essential compounds to the growth of plants is called Fertilizer. (Katyan 2008).

The presence of the microorganisms in the soil makes it living and dynamic process. The microorganism play a important role in the life cycle of plant and animals through several number of process such as decomposition, solubilization, nutrient fixation.

1.2Biofertilizer- Biofertilizer is a vital constituents of sustainable agriculture and soil fertility management. It enhance soil structure, texture, supply of nutrients proliferate useful soil- microorganism and water holding capacity. As they are renewable, pollution free and cheaper and non toxic therefore it provides ecological stability.

Algal biofertilizers have the unique quality to hold water and have tendency of concentrating nutrients like nitrogen and also scavenge sodium salt affected soil.

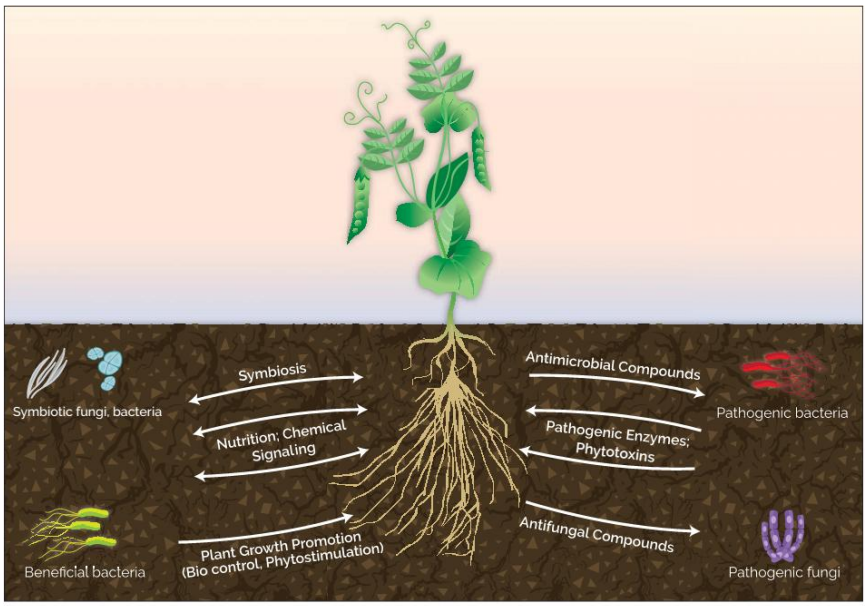
2.Soil-microorganism- Soil microorganism provide an crucial function in nourishing and protecting plants. They play an important role in providing soil, air, water services that are completely critical to human survival. A huge number of bacteria occurs in the soil. They are small in size hence they have smaller biomass.

Actinomycetes, bacteria and protozoa are strong and can accept more soil disturbances than fungal population so they dominant in virgin soil while fungal and nematode population tends to dominated in virgin soil (https://ohioline.OSU.edu/factsheet/SAG-16).

Only 40-60% of the applied fertilizer taken by the plant , the remain is missed to drain into waterways , votalization to the air or is tied up in the soil. Therefore soil health is such a critical piece of plant health.

Beneficial soil microbes from concerted relationships with the plants. Actually plant will apply as much as 30% of its energy to the root region to make food for microbes. In revert those microbes not only save the plant from stress, but also feed the plant by transforming and holding nutrients in the soil.
Different types of soil microbes and their function- There are five different types of soil microbes. Bacteria, actinomycetes , fungi, protozoa and nematodes.
Bacteria- Bacteria is the crucial workforce of soil. They are the final phases of split down nutrients and delivering them to the root tract for the plants. The Food and Agriculture organizing once said " Bacteria may will be the most valuable of live form in the soil."
Actinomycetes- Actinomycetes were once classified as fungi , and act similarly in the soil. Actinomycetes can also act as antibiotics for the plant.
Fungi- Fungi like bacteria & fungi also present in root tract and helps make nutrients available to plants.
Protozoa- Protozoa are larger microbes that prefer to absorb and be enclosed by bacteria . Infact nutrients that are eaten by bacteria are released when protozoa indeed eat the bacteria.
Nematodes- Nematodes are microscopic worms that lives around or inside the plant. Some nematodes are predators while others are useful eating pathogenic nematodes and emitting nutrient to the plant (htpps://www.holganix.com/blog/5-types-of-soil-microbes).

Other functions-
Conversion of nutrient to plant available form- Living organisms have a crucial role in controlling the transformations of plant nutrients in soil. In most soils, N, P and S are largely present as various organic compounds that are unavailable for plant uptake. Understanding the role of microorganisms in regulating the alteration of these organic pools into plant-available forms has received considerable attention.
Enhancement of nutrient recovery- Mycorrhizal fungi are constituent in symbiotic association
with the roots of 80% of land plants. Among the mycorrhizal fungi accomodate for specific association with plant species are ecto-mycorrhizal fungi (especially woody plants), arbuscular
mycorrhizal fungi (AMF, numerous crop plants), and ericoid mycorrhizal fungi. The AMF fungi perforate the root cells and form an elongation of the plant root system through hair-thin
strands (hyphae) that extend into the soil. The small diameter of the fungal hyphae allows greater access to soil pores than roots alone, providing better utilization of water and nutrients,
and maintaining root sorption activity in older parts of the root.



Representation of the complex interactions that take place in the rhizosphere between plant roots and microorganisms (from Haichar et al., 2014).

Promotion of root growth by improved soil structure -A frequently unnoticed input of soil microorganisms to plant nutrition is their enhancement of soil physical properties.
Good soil structure enhances plant root growth and consequences in greater drawing out of water and nutrients.
Controlling of pathogens - There is increasing admiration of the bond between soil

microbes and plant pathogen control. Several reports show the profit of soil microorganisms to improved plant growth and enhanced confrontation to disease and stress. (Ogilvie et al., 2008).

3.Bio-fertilizers- A substance which have living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and speed- up growth by increasing the supply or accessibility of key nutrients to the host plant is called biofertilizer. (Vessey, 2003). It add nutrients through the natural processes of nitrogen fixation, solubilising phosphorus, and stimulating plant growth through the synthesis of growth promoting substances.

It also helps the microorganisms restore the soil's natural nutrient cycle and construct soil organic matter. They increase crop yield upto 10-40% and fix nitrogen upto 40-50 kg. The other advantage is that after using 3-4 years frequently there is no require of application of bio-fertilizers because parental inoculums are sufficient for growth and multiplication. They enhance soil texture, pH, and other properties of soil. They produces plant growth promoting substances Indole acetic acid (IAA) , amino acids, vitamins etc. They have 75% moisture and it could be applied to the field directly. Bio-fertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be better to farmyard manure and other type of manure (Mukhopadhyay, 2006).

3.1Classification of bio-fertilizers: The bio-fertilizers are classified into four groups on the type of microorganisms as follows:-

1– *Algal bio-fertilizers:* Example: *Azolla*, Blue green algae (BGA) etc.
2– *Fungal bio-fertilizers:* Example: *Mycorrhiza* etc.
3– *Bacterial bio-fertilizers:* Example: *Azospirillum*, *Azotobacter*, Phosphobacteria, *Rhizobium*, etc.
4– *Actinomycetes bio-fertilizers:* Example: *Frankia* etc.

3.2Types of bio-fertilizers: There are three types of biofertilizers which aid the plant to grow at different levels of its growth.

1.Nitrogen bio-fertilizers: It helps the soil to proper its nitrogen level. Nitrogen is an vital component for plant growth but plants need it in a limited amount. Different soils have different requirement for nitrogen that is why it depends on the cultivated crops that which type of nitrogen bio-fertilizer should be used. ***Azotobacter*** is a bio-fertilizer which provides the necessary amount of nitrogen to the plant from the soil.

2.Phosphorus bio-fertilizers: Phosphorus is also a limiting factor and plants need it in particular amount. Phosphorus bio-fertilizers aid the soil to correct the phosphorus level. As nitrogen bio-fertilizers depend on the cultivating crops, phosphorus bio-fertilizers do not depend on the cultivating crops. ***Rhizobium*** is the phosphorus bio-fertilizer.

3.Compost bio-fertilizers: Compost bio-fertilizers are animals' wastes which are degraded by the bacteria and used as the most excellent naturally occurring bio-fertilizers. They not only protect the plants from diseases but also help them to grow in a healthy environment.

3.4Application of bio-fertilizers- four types of methods for application of bio-fertilizers:

– Seed treatment
– Set treatment
– Seedling treatment
– Soil treatment

3.5Role of bio-fertilizers in agriculture -They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops. They can at best minimize the use of chemical fertilizers not exceeding 40-50 kg N/ha under ideal agronomic and pest-free conditions.

They can add 20-200 kg N/ha year *(eg. Rhizobium* sp 50-100 kg N/ha /year; *Azospirillum , Azotobacter* : 20-40 kg N/ha /yr; Azolla : 40-80 kg N/ha; BGA :20-30 kg N/ha) under most favorable soil conditions and thereby increases 15-25 per cent of total crop yield.

Application of bio-fertilizers outcome in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation. Some bio-fertilizers *(eg, Rhizobium BGA, Azotobacter* sp) stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc. Phosphate mobilizing or phosphorus solubilising bio-fertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.) converts insoluble soil phosphate into soluble forms by secreting several organic acids and under most favorable conditions they can solubilise / mobilize about 30-50 kg P2O5/ha due to which crop yield may increase by 10 to 20%. Mycorrhiza or VA-mycorrhiza (VAM fungi) when used as bio-fertilizers

improve uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also improve resistance to root diseases and improve toughness of transplant stock. They act as antagonists and suppress the incidence of soil borne plant pathogens and thus, help in the biocontrol of diseases. Nitrogen fixing, phosphate mobilizing and cellulolytic microorganisms in bio-fertilizer enhance the agricultural production and farming system.

Blue green algae (BGA) like *Nostoc, Anabaena* and *Scytonema* are often employed in the recovery of alkaline soils. Bio-inoculants containing cellulolytic and lignolytic microorganisms improve the degradation/ decomposition of organic matter in soil, as well as enhance the rate of

decomposition in compost pit. BGA plays a crucial role in the nitrogen economy of rice fields in tropical regions. *Azotobacter* inoculants when applied to many non leguminous crop plants, endorse seed germination and initial vigour of plants by producing growth promoting

substances. *Azolla-Anabaena* grows freely as a floating plant in the flooded rice fields and can fix 100-150 kg N/ ha /year in approximately 40-60 tones of biomass produced.

3.6Constraints in Biofertilizer Technology -Though the biofertilizer technology is a low cost, eco-friendly technology, several constraints bound the application or implementation of the technology. The constraints may be:

-Technological constraints like unavailability of good quality carrier material and lack of qualified technical personnel in production units.

-Infrastructural constraints like lack of essential equipments, power supply, etc.

-Financial constraints like non-availability of sufficient funds and problems in getting bank loans.

-Environmental constraints like seasonal demand for biofertilizers, simultaneous cropping operations and short span of sowing/planting in a particular locality, etc.

-Human resources and quality constraints like lack of technically qualified staff in the production units, lack of suitable training on the production techniques.

-Unawareness on the benefits of the technology due to problem in adoption of the technology by the farmers due to different methods of inoculation, no visual difference in the crop growth immediately as that of inorganic fertilizers.

-Marketing constraints like non availability of right inoculant at the right place at the right time, lack of retail outlets or the market network for the producers.

(www.popularkheti.info© 2017 ISSN:2321-0001)

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