USE OF BIOFERTILIZER FOR SOIL HEALTH MANAGEMENT

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The indiscriminate use of synthetic fertilizers has led to the pollution and contamination of soil, water bodies and has diminished the microbial diversity in soil, thereby making crops more prone to biotic stresses. Depleting feedstock/fossil fuels (energy crisis) and increasing cost of fertilizers, have rendered inorganic fertilizers unaffordable to the small and marginal farmers. In this contest, it is very essential to supply the crops with a steady source of nutrients, preferably from organic sources. But presently farmers find it difficult to get the required quantity of farm yard manure (FYM) or composts due to various factors. In this context, the application of microbial inoculants i.e. biofertilizers would considerably reduce the financial and logistical burden of a farmer, besides being eco-friendly and affordable to the small and marginal small farmers.

Biofertilizers means the product containing carrier based (solid or liquid) living microorganisms, which are agriculturally useful in terms of nitrogen fixation, phosphorus solubilization or nutrient mobilization, to increase the productivity of the soil and/or crop plants. The regular use of biofertilizers like nitrogen fixer, phosphate, zinc and potash solubilizers, plant growth promoters and phosphate mobilizers found to speed up certain microbial processes in soil, which enhance the extent of availability of nutrients in a form easily assimilated by plants.

In general, soil structure has a strong impact on crop yield and the basic unit of soil structure is called as aggregates, which comprise solid material and pores. The mechanical and physical properties of soil is mainly depends on aggregates and it plays an important role for retention and movement of water, aeration, and temperature etc. Formation of soil stable aggregates strongly depends on both the nature and the organic matter content. It is well proved that the microbial activity in soil is one of the important factors for soil aggregation

process. e.g., mycorrhizal fungi, exopolysaccharide producing bacteria and blue green algae are playing pivotal role in soil aggregation process apart from nutrients supply to the crop plants. The role biofertilizers on soil health management is presented below

Blue green alga (BGA) is nitrogen fixing biofertilizer in rice helps in creating an environmentally safe agro-ecosystem, which remarkably adapt to a wide range of environment conditions. It exerts mechanical effect on soil particles thereby improving the stability of soil surface apart from retention of water storage. It also inûuences water inûltration rate, aeration, and soil temperature along with organic matter accumulation in the soil.

Azolla is a fast growing free floating freshwater fern and it fixes atmospheric nitrogen with help of BGA. Regular applications of Azolla in rice fields increase the rice yield and improve the soil health, physical and chemical properties of soil, enhances the microbial activities, increase the organic matte content. Hence, Azolla application is recommended for rice crop for sustaining soil fertility and crop productivity.

Rhizobium is one of the important nitrogen fixing biofertilizers and it has the ability to nodulate and fixes atmospheric nitrogen in symbiotic association with leguminous crops. This symbiotic association not only meets the nutrient requirement of the current crop, but also leaves a sizable amount of residual nitrogen for the succeeding crops and also helps to relieve the effect of water stress during the growth of plants. Host specific *Rhizobium* strains should be used for getting the desired results.

Azotobacter is a free living bacterium that fixes atmospheric nitrogen in the free living condition and produces thiamine, riboflavin, niacin, indole acetic acid, gibberellins and some fungistatic substances. It is less effective in soils with poor organic matter content; hence it is mandatory to apply sufficient quantities of organic amendments. ICAR-NRRI has recently identified an efficient entophytic nitrogen fixing *Azotobacter* (Avi2) from rice plants, application of which

saves more than 25 % of inorganic N fertilizer application to rice crop as compared to recommended dose.

Azospirillum is microaerophilic associative nitrogen fixing bacterium which fixes nitrogen and produces phytohormones that promote lateral root production leading to enhance the absorption of water and nutrients. *A. brasilense* and *A. lipoferum* are most commonly used.

The phosphate solubilizing bacteria (PSB) solubilize the insoluble phosphates and make them available for crop plants. Several soil bacteria and fungi notably species of *Pseudomonas, Bacillus, Penicillium* and *Aspergillus* etc. secrete organic acids and lower the pH in their vicinity to bring about solubilization of bound phosphates in soil. They help in increasing the crop yield and saving of P_2O_5 fertilizer dose up to 25-30 % of recommended level.

Arbuscular mycorrhizal fungi (AMF) associations are symbiosis between certain beneficial fungi and the roots of vascular plants. They play an important role in the uptake of major (P and N) nutrients by plants and mobilize other nutrients *viz*., K, Ca, Mg, S, Zn, Cu and Fe from soil. AMF associations increase the resistance of plants to pathogens particularly soil borne fungal pathogens by modification of cell wall, production of antimicrobial compounds and alteration of rhizosphere microorganisms.

Combined application of nitrogen fixing, phosphate solubilizing and mobilizing microbes or the microbial consortium to the crop plants has more beneficial effect on crop growth, yield and soil health as compared to individual inoculants application. Recently, ICAR-NRRI has evaluated Arka Microbial Consortium (containing nitrogen fixing, P and Zn solubilizing and growth promoting bacteria) for cultivation of rice under low land which could save 25 % of inorganic N or P fertilizers usage without compromising yield.

Overall, it indicates that the regular use of bio-fertilizers for agricultural production is very essential not only for economic benefits to the farmers but also improves and maintains the soil fertility and sustainability in natural soil ecosystem.

INTEGRATED NUTRIENT MANAGEMENT IN VEGETABLE CROPS

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Crops require mineral nutrients and the supply must be adequate for the targeted yield. Since the natural nutrient resources mostly provide only a part of the crop requirements, additional nutrients often are required. In many countries, however, the use of fertilizers is severely limited by water shortage, economical and environmental constraints. The continuous use of chemical fertilizers particularly NPK has impaired the soil fertility and decreased the factor productivity. The increasing cost of fertilizers with poor purchasing capacity and their negative effect on soil health has led to intensified attempts to the use of bio-fertilizers and organic matter along with inorganic fertilizers. So, at the farm field level IPNM therefore calls for an integrated and synergistic approach.

Definition

Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

Concepts

1. Regulated nutrient supply for optimum crop growth and higher productivity.
2. Improvement and maintenance of soil fertility.
3. Zero adverse impact on agro – ecosystem quality by balanced fertilization of organic manures, inorganic fertilizers and bio-inoculants.

Advantages

1. Enhances the availability of applied as well as native soil nutrients
2. Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources.