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ROLE OF BIOFERTILIZERS AND BIOPESTICIDES FOR SUSTAINABLE AGRICULTURE

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ABSTRACT

The use of chemical pesticides and fertilisers in Indian agriculture has seen a sharp increase in recent years and in some areas has reached alarming levels with grave implications for human health, the ecosystem and ground water. It is therefore urgent that environmental friendly methods of improving soil fertility, pests and disease control are used. Biofertilisers are considered as an important alternative source of plant nutrition.Biopesticides and Biofertilizers have emerged as a potential environment friendly inputs that are supplemented for proper plant growth. They hold vast potential in meeting plant nutrient requirements while minimizing the use of chemical fertilizers. These, bioinputs on supply to plants improve their growth and yield. A biofertilizer is an organic product containing a specific micro-organism in concentrated form which is derived either from the plant roots or from the soil of root zone. Due to heavy usage of chemical fertilizers and harmful pesticides on the crops, sustainability of the agriculture systems collapsed, cost of cultivation soared at a high rate, income of farmers stagnated , food security and safety became a scary challenge. Indiscriminate and imbalanced use of chemical fertilizers, especially urea along with chemical pesticides and unavailability of organic manures has led to considerable reduction in soil health. Biopesticides are target specific and does not leave harmful residues. They are the living organisms that can destroy agricultural pests. The adequate use of Bioinputs helps in restoring soil health and thus provides a cost effective way to manage crop yield along with balancing the environment.

Keywords: *Biofertilizers, Biopesticides, Agriculture, Micro-organism, Bioinputs or bioinoculants.*

NUMBER OF REFERENCES: 7

INTRODUCTION

During the past four decades we have witnessed the replication of the human population and a concurrent doubling of food production (Vance, 2001). Plant nutrition has played a key role in this remarkable increase in demand for and supply of food. Increase in crop production has been made possible through the use of commercial man-made fertilizers. The growth in agricultural production during the last three decades has been accompanied by a sharp increase in the use of chemical fertilizers, causing serious concern. The use of nitrogen (N) and phosphorus (P) fertilizer has increased almost manifold (Vance, 2001). The increasing use of fertilizers and highly productive systems have also created environmental problems such as deterioration of soil quality, surface water, and groundwater, as well as air pollution, reduced biodiversity, and suppressed ecosystem function (Schultz et al., 1995; Socolow, 1999; Vance, 2001). Clearly, there is an urgent need for sustainable agricultural practices on a global level. The potential and enormous scope of biopesticides and biofertilisers for promoting sustainable agriculture has been known for many years. Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Though the use of chemical inputs in agriculture is inevitable to meet the growing demand for food in world, there are opportunities in selected crops and niche areas where organic production can be encouraged to tap the domestic export market. The other important problem caused by the excessive and inappropriate use of chemical pesticides concerns the presence of pesticide residue in food. Many of the pesticides currently being used have a tendency to survive in plants for a long time. They also enter the food chain. The problem of pesticide residue is already a serious threat to health and environment in India. It is clear that the excessive use of chemical pesticides in agriculture is a serious cause of concern. It is, therefore, important that alternative, environmental friendly methods of plant protections are adopted, such as Integrated Pest Management (IPM) techniques; including the use of Biofertilizers and biopesticides. Biofertilisers are considered to be an important alternative source of plant nutrition. They are the preparations containing live or latent cells of efficient strains; micro-organisms such as bacteria, algae or fungi used for application to seed, soil or composting areas with the objective of increasing number of such micro-organisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants. They are biologically active products, with the ability to provide plants with nutrients and may be nitrogen fixers, phosphorus solubilizers, sulphur oxidisers or organic matter decomposers. In short, they are called as bioinoculants which on supply to plants improve their growth and yield. They are being essential component of

organic farming. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilise insoluble soil phosphates and produces plant growth substances in the soil. The incorporation of bio-fertilizers play major role in improving soil fertility, yield attributing characters and there by final yield has been reported by many workers. In addition, their application in soil improves soil biota and minimizes the sole use of chemical fertilizers. The role and importance of biofertilizers in sustainable crop production has been reviewed by many authors (Biswas et.al.1985; Wani and Lee, 1995; Katyal et.al. 1994).Application of biofertilizers is the only option to improve the soil organic carbon for sustenance of soil quality and future agriculture productivity (Ramesh, 2008). Organic farming, a production system that tends to skip the use of synthetic pesticides, fertilizers and other additives, relies heavily on biopesticides and biofertilizers.This paper explores the role of biofertilizers and biopesticides for sustainable agriculture.

Types of Biofertilizers

Most biofertilisers belong to one of two categories: nitrogen fixing and phosphate solubilising. Nitrogen fixing biofertilisers fix atmospheric nitrogen into forms which are readily useable by plants. These include Rhizobium, Azotobacter and Azospirillum, Blue Green Algae (BGA) and Azolla. While Rhizobium requires symbiotic association with the root nodules of legumes to fix nitrogen, others can fix nitrogen independently. Phosphate solubilising micro-organisms such as Bacillus, Pseudomonas, Aspergillus etc. secrete organic acids which enhance the uptake of phosphorus by plants by dissolving rock phosphate. Some others are phosphate mobilizers and Zinc solubilizers.The nitrogen fixers like Rhizobium, Azospirillum and Azotobacter, BGA and Phosphate solubilizing bacteria and phosphate mobilizing-mycorrhiza have been widely accepted as bio-fertilizers. A considerable amount of research has been done to establish the effectiveness of biofertilisers on various crops, in different agro-climatic regions. The use of biofertilisers can have a significant effect on the yield of most crops. However, their effectiveness is found to vary greatly, depending largely on soil condition, temperature and farming practices.

Advantages of biofertilizers

Renewable source of nutrients;Sustain soil health and increase the grain yields by 10-40%;Supplement chemical fertilizers and replace 25-30% chemical fertilizers;Decompose plant residues, and stabilize C: N ratio of soil;Improve texture, structure and water holding capacity of soil.;Stimulates plant growth by secreting growth hormones and has No adverse effect on plant growth and soil fertility;Solubilize and mobilize nutrients.;Eco-friendly, non-pollutant and cost effective method.

Limitations of biofertilizers

Non availability of appropriate and efficient strains of bacteria.Lack of suitable carrier,

due to which self life is short, is another constraint.Marketing of biofertilizer is not easy as the product contains living organisms.Seasonal demand and production of biofertilizers.Scarcity and Viability of VAM inoculum during storage and transportation is the major problem.Lack of awareness of farmers.Inadequate and inexperienced staff.

Biopesticides and Bio-control Agents

During the Green Revolution, achieving high crop yields at any cost was the ultimate goal. The emphasis now is on sustainable agriculture-increasing yields without harming the environment. Biopesticides are a vital component of sustainable agriculture. They are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.

Biopesticides fall into three major classes:

Microbial pesticides consist of a micro-organism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest[s]. For example, there are fungi that control certain weeds, and other fungi that kill specific insects. The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. Each strain of this bacterium produces a different mix of proteins, and specifically kills one or a few related species of insect larvae. While some Bt's control moth larvae found on plants, other Bt's are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larvae to starve.

Plant-Incorporated-Protectants (PIPs) are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt. pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the Bt. bacterium, manufactures the substance that destroys the pest. Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are generally synthetic materials that directly kill or inactivate the pest. Biochemical pesticides include substances, such as insect sex pheromones that interfere with mating as well as various scented plant extracts that attract insect pests to traps.

The advantages of biopesticides:

Biopesticides are usually inherently less toxic than conventional pesticides. Biopesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects, and mammals. Biopesticides often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. When used as a component of Integrated Pest Management (IPM) programs,

biopesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. To use biopesticides effectively; however, users need to know a great deal about managing pests.

Disadvantages of Biopesticides:

Instability of the protection effect, a limited period of activity - and usually are used with normal pesticide application techniques, Difficulty in establishment of the biopesticide agents in the fields, Ambiguity of modes of protection, Low potency and High cost of production.

Strategies for sustainable agriculture development:

Identification/selection of efficient location/ crop/soil specific strains for N-fixing, P, Zn-solubilizing and absorbing (mycorrhizal) to suit different agro climatic conditions, Strain improvement through biotechnological methods, Exchanging the cultures between their performance for countries of similar climatic conditions and evaluating during better strain for particular crop, checking the activity of cultures storage to avoid natural mutants, technical training on the production and technical advice and projects quality control to the producers and rendering, to manufacturers, organizational training to the extension workers and farmers technology and dissemination of information through mass to popularize the media, publications and bulletins.

CONCLUSION

Biofertilizers have an important role to play in improving nutrient supplies and their crop availability in the years to come. They are of environment friendly and low cost agricultural inputs. They play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric nitrogen, mobilizing fixed macro and micro nutrients and convert insoluble phosphate in the soil into forms available to plants there by increase their efficiency and availability.Among the biofertilizers Azoto-bacter, Azospirillum and Acetobacter are the important for nitrogen fixation, *Bacillus* sp. and *Aspergillus* sp. are important for phosphate solubilisation and other soil mineral nutrients. Application of biofertilizers is the only option to improve the soil organic carbon for sustenance of soil quality and future agriculture productivity.

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