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Technologies, limitations and constraints in phosphorus application through biofertilizers in organic farming

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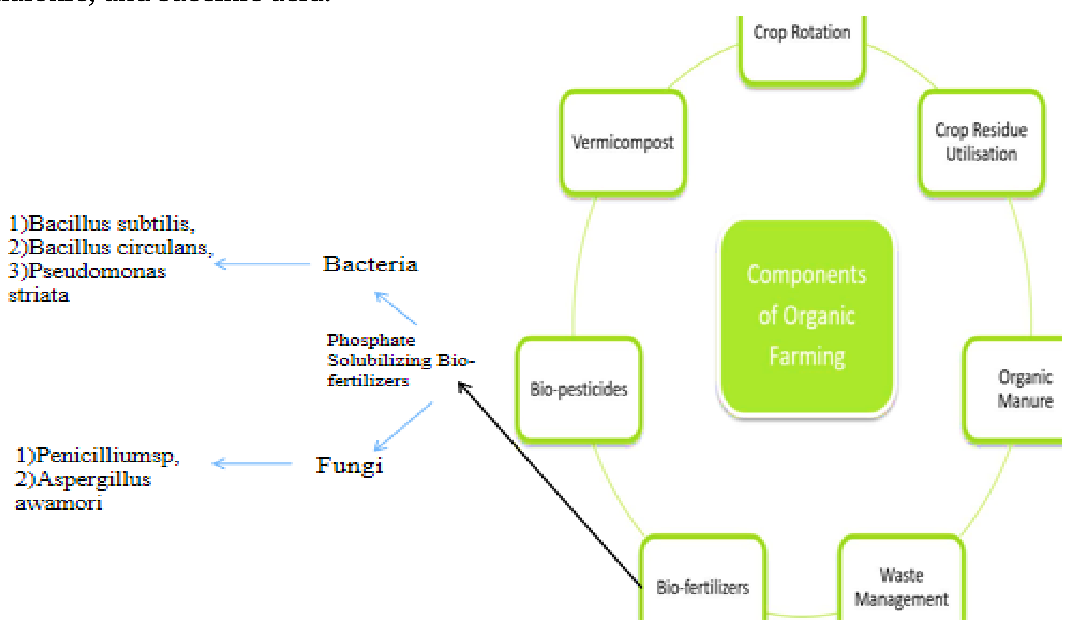
Introduction

Phosphorus is an 2nd most essential element for plant development and growth making up about 0.2 % of plant dry weight. Plants acquire P from soil solution as phosphate anions. However, phosphate anions are extremely reactive and may be immobilized through precipitation with cations such as Ca^{2+}, Mg^{2+}, Fe^{3+} and Al^{3+} (such as tricalcium phosphate, dicalcium phosphate, hydroxyapatite). Different bacterial species has ability to solubilize insoluble inorganic phosphate compounds, by producing organic acids lactic, isovaleric, iso-butyric and acetic acids, glycolic, oxalic, malonic, and succinic acid.



Microbe based technologies developed by ICAR

Bio NPK Liquid Formulation: P-solubilizing (Paenibacillus tylopili)

BIOGROW Liquid Formulation: Developed using consortium of different bacterial species "viz., Bacillus sp. BC39, Bacillus sp. RC25, Pseudomonas sp. K30 and Pseudomonas sp. K31," endowed with phosphorus solubilization, IAA and siderophore production attributes.

Biofort: Bacillus aryabhattai MDSR14: A potential rhizobacteria for scavenging native phosphorus and zinc from soil for improved biofortification in Soybean and Wheat Grown in Vertisols

Bio Phos and Bio Phos+ Liquid Formulation: Bio Phos and Bio Phos+ are liquid formulations of P-solubilizing bacteria containing Kluyvera cryocrescens and Paenibacillus tylopili respectively

On-Farm Production Technology for AM Fungal Biofertilizer: AMF consortium of Glomus mosseae, Glomus intraradices and Glomus sp.

Soilless Arbuscular Mycorrhizal Fungal Inoculum: soilless production of AM fungal inoculum by utilizing sterile Arka Fermented Cocopeat as the sole substrate for host plant growth with the intervention of a mycorrhizal helper bacterium (Pseudomonas taiwanensis)

Limitations in adoption of biofertilizer:

The major constraints in use of biofertilizers faced by the farmers were **lack of confidence towards various biofertilizers practices**, lack of knowledge about biofertilizers, Inadequate water availability and lack of guidance from expert personnel.

Apart from this, India being a semi-arid region where the oxidation of SOM is at faster rate because of high temperatures and the soils are very low in organic carbon, but the bioinoculants in biofertilizers require food (carbon source) for their survival and reproduction. There by application of these biofertilizers has not fetch much results to farmer fields.

Constraints in Biofertilizer Technology: Though the biofertilizer technology is a low cost, ecofriendly technology, several constraints limit the application or implementation of the technology the constraints may be environmental, technological, infrastructural, financial, human resources, unawareness, quality, marketing, etc. The different constraints in one way or other affecting the technique at production, or marketing or usage.

1. Technological constraints:

- Use of improper, less efficient strains for production.
- Lack of qualified technical personnel in production units.

• Production of poor-quality inoculants without understanding the basic microbiological techniques

• Short shelf life of inoculants.

2. Infrastructural constraints

• Non-availability of suitable facilities for production

• Lack of essential equipment, power supply, etc.

• Space availability for laboratory, production, storage, etc.

• Lack of facility for cold storage of inoculant packets.

3. Financial constraints:

• Non-availability of sufficient funds and problems in getting bank loans

• Less return by sale of products in smaller production units.

4. Environmental constraints:

• Seasonal demand for biofertilizers

• Simultaneous cropping operations and short span of sowing/planting in a particular locality

• Soil characteristics like salinity, acidity, drought, water logging, etc.

5. Human resources and quality constraints

• Lack of technically qualified staff in the production units.

• Lack of suitable training on the production techniques.

• Ignorance on the quality of the product by the manufacturer

• Non-availability of quality specifications and quick quality control methods

• No regulation or act on the quality of the products

• Awareness on the technology

• Unawareness on the benefits of the technology • Problem in the 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.

Conclusions:

- Phosphate-solubilizing microorganisms have tremendous potential as Bio-fertilizers. Mobilizing soil inorganic phosphate and increasing its bioavailability for plant use by harnessing soil.
- PSM promotes sustainable agriculture, improves the fertility of the soil, and hence increases crop productivity.

- The use of PSM as microbial inoculants is a new horizon for better plant productivity by root dipping, soil application, seed treatment, soil drenching
- PSM technology can contribute to low-input farming systems and a cleaner environment.
- Combine use of phosphate solubilizing microorganisms and organic manure has greater agronomic utility as it could improve phosphorous (P) utilization efficiency through conversion of insoluble P to accessible forms.

However, there is need to develop PSB technologies specific to various regions and this should be communicated to farmers in a relatively short time