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FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Introduction

Bio-fertilizers are selective live micro-organism like bacteria, fungi and algae. They provide a cost effective, eco-friendly &renewable source of nutrients. Bio-fertilizers improve the nutrient availability to the crops in which biological process is involved. They play a vital role in improving soil fertility and ensure maintaining long term sustainability.

Bio-fertilizers become popular to counter the negative impact of indiscriminate use of chemical fertilizers. Chemical fertilizers and pesticides have played a important role in boosting the agricultural production for past 50 years in India, since their introduction during green revolution. Their immediate action and low cost resulted in the widespread acceptance and inclusion in cultivation practices. However their long term application contributed in loss of soil fertility along with addition of salts to the soil. This led to concern for reviving the soil health and use of alternate sources of fertilizers. Thus came the concept of bio-fertilizer, which proved to be a good supplement for chemical fertilizers.

Bio-fertilizer is the need of modern agriculture since demand for safe and residue free food is increasing. In view of the shifting focus towards organic farming and reduction of chemical residues in the environment, it is necessary to promote the production of bio-fertilizers in large scale by the private sector to cater the current demand. Bio-fertilizers help in fixing atmospheric nitrogen, converting soil phosphate and potash into soluble forms to make them available to plants. Continuous use of bio-fertilizers makes the soil rich in essential nutrients, which promotes good yield. The bio-fertilizer can be manufactured both in solid as well as in liquid form.

National Scenario:

Govt. of India and different State Governments have been promoting use of Bio-fertilizers through grants, extension and subsidies on sales with varying degrees of emphasis. With time farmers are getting training and knowledge about the technology on the basis of agronomic realities of their regions. Thus farmers are being encouraged to adopt the use of Bio fertilizers.

Government of India has been implementing the scheme for the promotion of bio-fertilizers since 7th Five Year Plan. Under this scheme, one national centre-NCOF and six regional centres-RCOFs have been established. The main function of these centres includes the promotion of bio-fertilizer through training, demonstration and supply of 10 efficient culture for production of bio-fertilizers. The scheme also aims for giving grant up to Rs. 40 lakh per unit of 150 tonnes per year to set up bio- fertilizer producing units. Since inception bio-fertilizer production capacity of 10,525 tonnes has been envisaged by setting up 83 bio-fertilizer production units. Out of these units, 9 units have been sanctioned by the Department of Fertilizers under their scheme of providing financial assistance for the purpose and 74 units have been financed by Department of Agriculture & Cooperation. Another 39 units have current demand for bio-fertilizers in India is 18,500 tonnes per year, whereas estimated production is about 10,000 tonnes per year in been set up by different organizations and private entrepreneurs with a production capacity of 7,975 tonnes per year.

The total estimated the country. Moreover Govt. of India is focussing on generating additional demand through proper extension and promotion by regularly organizing Seminars on bio-fertilizers and micronutrients.

Location analysis

It is advisable to set up one Bio fertilizer production unit in centralized location of each of four geographical parts (North, South, East and West) of the state. Each of these units will thus be able to cater up to approximately 200km2areas.
The site for setting up of unit should have good road connectivity and supply of electricity with support for uninterrupted power supply.

Availability of Raw material

Raw materials needed for the production of biofertilizers are as follows:

- Mother Cultures
- Carrier material - lignite or bentonite or peat of desired quality in powder form (70-100 mesh)
- Pet bottles of desired quantity, cardboard cortans
- Growth materials - include Manital, sucrose and chemical nutrients**.**

➢ **Mother Culture:** The pure mother cultures of various strains are being maintained in Agricultural Universities, IARI, some ICAR institutions, NCOF, MoA (Regional bio-fertilizer labs), etc. There are international sources of supply also like NifTAL (Improved Agricultural Productivity through Biological Nitrogen Fixation Technology and Legume Management), IRRI (International Rice Research Institute) etc. The mother culture in test tubes of desired strain can be purchased from the identified sources. They have to be further sub-cultured and maintained for mass production by adopting standard techniques under the supervision of trained microbiologist.

➢ **Carrier material:** For solid formulations there is a requirement of lignite / bentonite / charcoal / peat of desired quality in powder form (70-100 mesh). However, the solid formulation technology is gradually becoming obsolete because of the issues relating to the quality and stability of the product. The solid state formulation is sensitive to temperature and during mid-summer, in Odisha the microbial count comes below the threshold limit. In comparison the liquid formulation is much stable technology and the self-life of the product can be maintained very well up to 12 months. The production of liquid Bio fertilizer does not need any carrier material for the final product. For production, it requires only water and chemicals. The quantity produced in the Fermenters then directly packed in bottles and sold. Therefore the liquid- biofertilizer will be most suitable.

➢ **Growth materials:** The liquid formulation needs water and certain chemicals as Manital, sucrose and chemical nutrients as growth medium. These chemicals are easily available through any supplier/ distributor of lab- chemicals.The chemicals required for the production of bio-fertilizer are:

➢ **Carbon Source** - Malic acid, Sucrose, Glucose, Manitose.

➢ **Nitrogen Source** - Yield extract, Ammonium sulphate, Peptone.

➢ **Micro-Nutrients** - Mg sulphate, Zn sulphate, Co nitrate.

➢ **Stabilizers/ Surfactant** - Polyethylene Glycol, Glycerol, PVP.

Microorganism to be used in the said facility for production of the bio-fertilizer range is as follows:

i. Rhizobium
ii. Azotobacter
iii. Azospirillium
iv. Phosphate Solubilising bacteria (PSB)
v. Potash Mobilizing Bacteria (KMB)
vi. Trichoderma for compost production.

Carrier-based biofertilizers

At present, biofertilizers are supplied as carrier-based microbial inoculants which are added to the soil to enrich t
soil fertility. The carrier is a medium that can carry the microorganisms in sufficient quantities and keep them viab
under specified conditions, easy to supply to the farmers. The use of ideal carrier material is necessary in the production of good quality biofertilizer.

- A good carrier should have the following qualities:
- Highly absorptive (water-holding capacity) and easy to process;
- Non-toxic to microorganisms;
- Easy to sterilize effectively;
- Available in adequate amounts and low-cost;
- Provide good adhesion to seeds;
- Has good buffering capacity;
- High organic matter content and water-holding capacity of more than 50%.

Other essential criteria for carrier selection relating to the survival of the inoculant bacteria should be considered

- Survival of the inoculant bacteria on seeds. Seeds are not always sown immediately after seed coating with inoculant bacteria. The bacteria have to survive on seed surface against drying condition until placed into soil.
- Survival of the inoculant bacteria during the storage period.
- Survival of the inoculant bacteria in soil. After being introduced into the soil, the inoculants bacteria have to compete with native soil microorganisms for the nutrient and habitable niche, and have to survive against grazin protozoa. Such carrier materials that offer the available nutrient and/or habitable micro-pores to the inoculants bacteria will be desirable. In this sense, materials with micro-porous structure, such as soil aggregate and charco will be good carriers for soil inoculants.

Liquid biofertilizers

The strength of biofertilizers is determined by two basic parameters: number of cells and efficiency of the microorganisms to fix nitrogen or solubilize phosphates.Liquid biofertilizers are liquid formulations containing the dormant form of desired microorganisms and their nutria along with the substances that encourage formation of resting spores or cysts for longer shelf-life and tolerance adverse conditions. The dormant forms, on reaching the soil, germinate to produce a fresh batch of active cells. These cells grow and multiply by utilizing the carbon source in the soil or from root exudates. As an alternative to conventional carrier–based biofertilizers, liquid formulation technology, which has more advantages than the carrier-based inoculants, has been developed in the Department of Agricultural Microbiolog TNAU, Coimbatore. The advantages of liquid biofertilizers over conventional carrier-based biofertilizers are listed below:

- Longer shelf life, 12-24 months;
- No contamination;
- No loss of properties due to storage up to 45º C;
- Greater potential to fight with native populations;
- High populations can be maintained at more than 10 cells/ml up to 12 to 24 months;
- Easy identification by typical fermented smell;
- Cost saving on carrier material, pulverization, neutralization, sterilization, packing and transport;
- Quality control protocols are easy and quick;
- Better survival on seeds and soil;

- No need of running biofertilizer production units throughout the year;
- Very much easy to use by the farmer;
- Dosages are 10 times less than those of carrier-based powder biofertilizers;
- High commercial revenues;
- High export potential;
- Very high enzymatic activity, since contamination is nil.