Biofertilizer Production under Compulsory Experiential Learning Programme in the Department of Soil Science and Agricultural Chemistry

Introduction

Human civilization is continuously being threatened by two serious issues, namely, food insecurity and climate change. Now the mankind has two primary demands availability of sufficient food to survive and improving the quality of life. Both the problems and the demand are directly or indirectly related to soil fertility and productivity of food crops. The worldwide steady increase of population is continuously exerting pressure on the limited natural resource base, making it difficult to produce more food and fibre. As agricultural productive land is becoming very much scarce day-by-day, vertical development in productivity is a matter of concern instead of horizontal expansion. At times of rising food prices, escalating population and growing concern over global food security, farmers need to enhance levels of food production from the limited cultivable area through the development of agricultural biotechnology, seed inoculation with proper bio-organisms and intensive but appropriate agricultural practices. Although vertical development of agriculture requires extensive use of chemical fertilizers, it results in numerous problems like nutrient imbalance, micronutrient deficiency, deterioration of soil health and stagnating crop yields. Under this situation, it calls for renewable and sustainable alternatives. The new approach for farming, often referred to as 'sustainable agriculture", advocates the use of renewable inputs like biofertilizers, green manures, vermicompost, etc., of which biofertilizer use is especially important from the view points of environmentally safe technology and providing some sort of fertilizers to the resource-poor and marginal farmers. Seed inoculation, Soil application and foliar application with biofertilizer, are a low-cost input which plays a significant role in raising crop productivity and enhancing nutrient availability to the crop plants. Biofertilizers or microbial inoculants can be generally defined as any preparations containing live or latent cells of efficient strains of nitrogen fixing and phosphate solubilizing microorganisms used for the treatment of seeds or soil. Seed inoculation with biofertilizer is belonging to one of the categories viz. nitrogen fixing, phosphate solubilizing and mobilizing, and plant growth promoting. Nitrogen fixing organisms fix atmospheric nitrogen into forms which are readily taken up by plants, and these include *Rhizobium* and *Azotobacter*. Phosphate solubilizing and mobilizing microorganisms dissolve or mobilize inorganic and organic sources of phosphorous for easy uptake by plants. Some of the rhizobacteria can directly promote the plant growth by the production of hormones.

Background

Environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contributes largely to the deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide (CO_2) and contamination of water resources. It leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and causes soil degradation. In nature's laboratory there are a number of organisms (micro and macro) that have the ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are critical for maintaining soil productivity. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation.

These will be integral component of our future farming system. From the points of sustainable agricultural development and good eco-environment establishment, use of biofertilizers in sustainable pulse production, besides improving soil health and fertility, is a scientific proposition

Objectives:

This initiative may be introduced to promote organic farming in the country on a large scale. These products of biofertilizer may be used in the natural farming also for improving its efficiency. Under this scheme manufacturing of organic inputs like Biofertilizers i.e., *Rhizobium* (symbiotic), *Azotobacter* (non-symbiotic), *Azospirillum* (suitable for C4 plants) and phosphate solublising microorganisms (*Bacteria*/*fungi*) are to be under taken with the following objectives.

- Production of various strains of good quality biofertilizers using most modern technology for the farmers of the region.
- To develop the technical as well as managerial skills and awareness thereby enhancing the professional confidence of the students.
- To provide farmers an opportunity to develop a set of skills such as leadership, teamwork, interpersonal communication, analytical problem solving, entrepreneurial/business skills.
- To train the students regarding infrastructure facilities for culture selection, maintenance, culture augmentation, carrier sterilization, packing, grading and finally bagging etc.
- To make aware the students for maximum production of suitable crop specific and site specific biofertilizers using sophisticated instruments and laboratory facilities.
- To create general awareness and provide education and training to the farmers. This will also benefit the farmers, entrepreneurs and extension personnel to promote sustainable crop production.
- It will also create ways for production and simultaneously profitable marketing.

Preliminary work done so far:

Our institute has a Soil Testing Laboratory and side by side conducting different trial on biofertilizers. There is a compulsory experiential learning course of biofertilizer production in the under graduate syllabus.

Outline of Bio-fertilizers production:

a) Isolation of nodule bacteria from root nodules:

Selection of suitable healthy plants

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Collect fresh, healthy nodules

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Deep in $HgCl_2$ solution for 5 minutes

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Wash with sterile water for 2-3 minutes

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Deep in 75% ethanol for 2-3 min.

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Wash with sterile water for 2-3 minutes

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Crush sterile glass rod with the help of 1.0ml water

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Inoculate in 10 ml media suspension and gradually serial dilution up to 6 times

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Finally inoculate in a fine petriplate

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Inoculate in a test tube from a single colony

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Prepare mother culture through sub-culturing from single colony of test tube

b) Culture selection and maintenance:

The pure mother culture should be maintained properly and they have to be further sub-cultured to maintain purity for mass production by adopting standard techniques under supervision of trained personnel or microbiologist.

c) Culture augmentation:

The culture has to be mass multiplied in two stages namely

i. Primary stage using shakers in flasks (Primary inoculums or PI) i.e., 1-5% of final broth.
ii. Secondary stage multiplication in fomenters (final broth for mixing).

Schematic diagram showing multiplication stages of Biofertilizer mother culture:

Media preparation & Sterilization

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Maintenance of culture

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Petri plate streak for isolated colonies → test tube culture → flask bottle inoculation → bottle broth inoculation (PI)

d) Carrier sterilization:

Chart showing steps in biofertilizer production:

Mother culture

↓

Bioreactor

↓

Carrier sterilization→ Blender

↓

Curing

↓

Packaging

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Storage

e) Mixing and packaging:

It will be done following the special sophistication and automation of the unit. Generally 2-3 alternatives are followed.

Production:

Sl.No.	Activity	Material produced
1.	Rhizobium Spp.	Around 20 Kg
3.	Azotobacter	Around 40 Kg

Note:

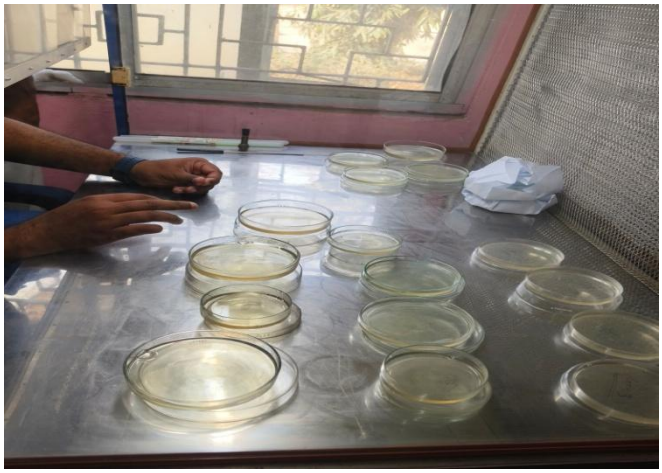
i. Every students produces 2 packets of both *Rhizobium* (200g/packet) and *Azotobacter* (400g/packet)

ii. *Rhizobium* spp. Collected from pulse crop cultivated in the field of nearer farmers or Agricultural Farm, PSB, Visva-Bharati

iii. *Azotobacter /Azospyrillum* spp also collected from field of nearer farmers or Agricultural Farm, PSB, Visva-Bharati

Utilization of Products:

The produced Biofertilizer mostly used in the Agricultural farm, RKVK and in the research work of M.Sc and Ph.D thesis.

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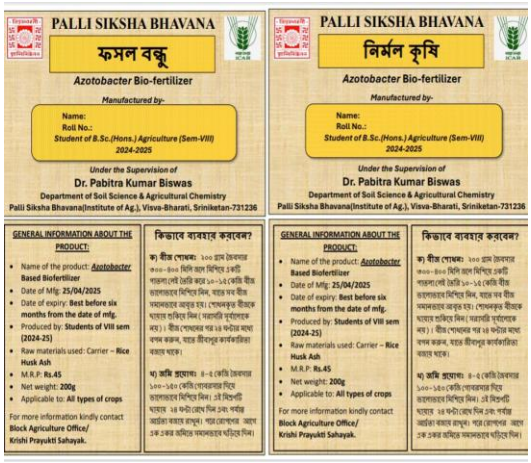
PALLI SIKSHA BHAVANA
ফসল বন্ধু
Azotobacter Bio-fertilizer
Manufactured by-
Name:
Roll No.:
Student of B.Sc.(Hons.) Agriculture (Sem-VIII)
2024-2025
Under the Supervision of
Dr. Pabitra Kumar Biswas
Department of Soil Science & Agricultural Chemistry
Palli Siksha Bhavana(Institute of Ag.), Visva-Bharati, Sriniketan-731236
GENERAL INFORMATION ABOUT THE PRODUCT:
Name of the product: Azotobacter Based Biofertilizer
Date of Mfg: 25/04/2025
Date of expiry: Best before six months from the date of mfg.
Produced by: Students of VIII sem (2024-25)
Raw materials used: Carrier – Rice Husk Ash
M.R.P. Rs.45
Net weight: 200g
Applicable to: All types of crops
For more information kindly contact
Block Agriculture Office/
Krishi Prayukti Sahayak.
কিভাবে ব্যবহার করবেন?
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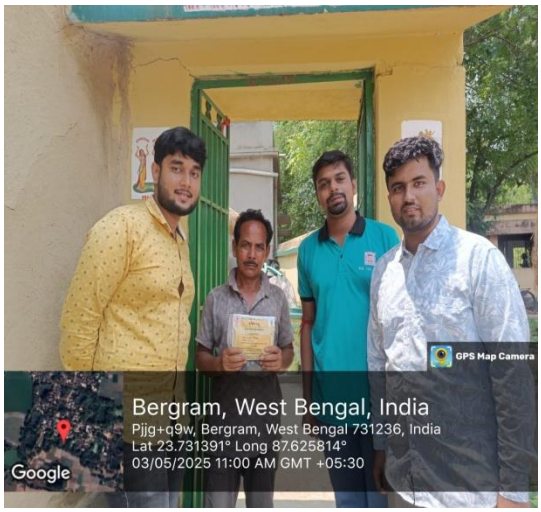
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