# ON JOB TRAINING REPORT

**On**

## 'Bio Innovations for Sustainable Agriculture'

**Submitted to**

**Department of Zoology, Vivekanand college, Kolhapur**

**(An empowered autonomous institute)**

**For**

**MSc I, Semester II**

**by**

**Ms. Vaishnavi Vinod Abrange(1001)**

**Under Supervision of**

**Dr. Supriya Kusale** *PhD ( Microbiology)*

**Founder and Director**

**SHREEL SURYA RESEARCH PRIVATE LIMITED**

**Kolhapur.**

**(Duration: 1st April 2026 – 15th April 2026)**



Scanned with OKEN Scanner

# CERTIFICATE

This is to certify that the On Job Training report on 'Bio innovations for a sustainable agriculture' which is being submitted here with for the M.Sc. I, semester II, in department of Zoology Vivekanand college, Kolhapur is the result of the on job training at Shreel Surya Research Pvt. Ltd. and written by **Ms. Vaishnavi Vinod Abrange(1001)** under the supervision of **Dr. Supriya Kusale** (Founder and Director, Shreel Surya Research Pvt. Ltd.)and the OJT is assisted by **Ms. Ekta Kamble**. She has completed her 15 days On Job Training successfully.

Place: Kolhapur

Date: 15 / 4 /2026

V.V. Abrange

Miss Vaishnavi Vinod Abrange (1001)

Student

Ms. Ekta Kamble

Mentor

HOD

Department of Zoology,

Vivekanand College, Kolhapur.

Head
Department of Zoology
Vivekanand College Kolhapur
(An Empowered Autonomous Institute)



Scanned with OKEN Scanner

# SHREEL SURYA RESEARCH PVT.LTD.

## CIRTIFICATE OF ON JOB TRAINING

This is to certify that **Ms. Vaishnavi Vinod Abrange(1001)** student of Department of Zoology, Vivekanand college Kolhapur, has successfully completed 'On Job Training program' entitled **'Bio innovations for sustainable agriculture'** from **1st April 2026** to **15th April 2026** in our company **SHREEL SURYA RESEARCH PVT. LTD.** at **Valivade , Kolhapur.**

SHREEL-SURYA RESEARCH PRIVATE LIMITED

**Founder and Director**

**Dr. Supriya Kusale** *Ph.D( Microbiology)*



Scanned with OKEN Scanner

# ACKNOWLEDGEMENT

First, I would like to thank Dr. Supriya Kusale, founder and director of Shreel Surya Research Pvt. Ltd., Kolhapur, for giving me the opportunity to do an on job training within the company.

I would like to thank all the people that worked along with me in Shreel Surya Research Pvt. Ltd., with their patience and openness they created. It is indeed with a great sense of pleasure and immense sense of gratitude that I acknowledge the help of these individuals.

I am highly indebted to Dr. Supriya Kusale, for the facilities provided to accomplish this on job training.

I would like to thank to Head of the Department of Zoology Dr. G. K. Sontakke for his constructive criticism throughout internship. I would like to thank Ms. Ekta Kamble for their support, guidance and advices to get and complete on job training in above said organization.

I am extremely great full to my department staff members and friends who helped me in successful completion of this on job training.

V.V.Abrange

Vaishnavi Vinod Abrange (1001)



Scanned with OKEN Scanner

# TABLE OF CONTENTS





Scanned with OKEN Scanner

# INTRODUCTION TO THE COMPANY

SHREEL-SURYA RESEARCH PRIVATE LIMITED is a specialized agro-biotech company offering a microbial platform for sustainable farming. Dr. Supriya Kusale is the founder and director of the company. This company took birth from an idea to support economically sustainable agriculture. They have over six years of bringing out the best microbial solutions through in-house research. Each product has been perfected technically, and the channel is supported in all possible ways till it reaches the farmers and imparts benefit. Company's mission is to improve agriculture with cost-effective microbial solutions, promoting organic practices. They offer the latest technology solutions to feed the crops, protect them from pests & diseases and manage soil fertility from seed to harvest. Efficient strains have been collected, tested, and selected with award-winning and patented formulation processes into hi-tech products.

SHREEL-SURYA RESEARCH PRIVATE LIMITED dreams of transforming agriculture sustainably. They are the inventors of liquid bio-fertilizers for N, P, and K supplementation. Novel methods of using microbes on seed, in the rhizosphere, and on foliar surfaces provide multiple benefits to the farmer. They have devised a unique one-stop service to help farmers achieve the best results. They are India's largest producer of organic – microbial fertilisers for foliar, drip and soil applications. All products are registered at FCO. Their bio-pesticide plant produces microbial formulations for nematode, fungal and insect management in crops. All products are registered at CIB–RC. Meeting compliance and going beyond it Compliance at SHREEL-SURYA RESEARCH PRIVATE LIMITED is seen as a way to reach the farmers' best quality inputs. We target zero pollution norms with 99% recycling of waste. Their products also reduce the chemical and carbon footprint.

**Company's vision:-**

- Affordable innovation for farmers.
- Increasing yields.
- It reduces the cost of cultivation.
- Responsible cultivation practices.
- Healthy food, soil, water, and environment.



Scanned with OKEN Scanner

# INTRODUCTION TO THE ON JOB TRAINING

As per National Education Policy 2020, in the academic year 2025-26. M.Sc.1 students have on job training to learn new things in addition to the daily curriculum. Under this, students are required to work in different organizations outside the college, which enables them to acquire skills required for future work. I chose Shreel Surya Research Pvt Ltd for job training. The company is a producer of bio-fertilizers, and their aim is sustainable development of agriculture through organic farming. The job training was for one month. For this 15 days training Dr. Supriya Kusale (Founder & Director) organized a training program assisted by Ms. Ekta Kamble (Research assistant) titled 'Bio innovations for Sustainable Agriculture' to empower students for sustainable innovations.

This comprehensive one-month internship was specially designed for MSc Zoology students. The training focuses on the entire life cycle of biofertilizer production, marketing strategies and practical projects. Bioethanol production techniques, vermicompost production, field trials on various vegetables were also included in this training. Guest lectures were organized to impart more knowledge to the students, and field visits were also conducted.

**Key highlights of this training**

**1.Biofertilizer Production:** Learn the intricacies of producing high-quality biofertilizers.

**2.Soil Testing:** Participate involve in soil testing of farmer by generating the report. They analyze the report and understand the condition of soil.

**3.Vermicomposting:** Gain practical knowledge of vermicomposting techniques and their benefits for sustainable agriculture.

**4.Isolation and Optimization of PGPR isolate**

**5.Marketing Strategies:** Develop effective marketing skills tailored to the biofertilizers industry.



Scanned with OKEN Scanner

# INTRODUCTION TO LAB

## INSTRUMENTS:

### 1. Laminar air flow:


**Type:** Horizontal

**Company:** RESCHOLAR

Mechanism: The laminar air flow principle relies on creating a sterile, contamination-free workspace by directing HEPA-filtered air in a steady, unidirectional (single-direction) stream at a uniform velocity (0.3 to 0.5 m/s). By maintaining a smooth flow, it prevents air turbulence, ensuring particles are swept away from the workspace.

**Key Principles and Components:**

Unidirectional Flow: Air flows in parallel, uniform layers (either horizontally or vertically) to prevent mixing or stagnation.

HEPA Filtration: Air is drawn through a pre-filter to remove large particles and then forced through a High-Efficiency Particulate Air (HEPA) filter, which removes  of contaminants  or larger.

Positive Air Pressure: The cabinet maintains a consistent, positive pressure to prevent unfiltered, contaminated external air from entering the workspace.

Contaminant Removal: By ensuring a continuous, clean airflow across the surface, it constantly removes any particulates generated during work.

Types of Laminar Air Flow:

Horizontal: Air moves from the back of the cabinet toward the operator, providing a sterile environment for larger items.

Vertical: Air moves from the top of the cabinet downward to the work surface, often providing better operator protection and suitability for volatile powders.



Scanned with OKEN Scanner

## 2. Autoclave:


**Company :** LABLINE

**Mechanism :** An autoclave sterilizes equipment by using pressurized, saturated steam to achieve high temperatures typically 121C that denature microbial proteins and destroy spores. It operates via moist heat sterilization, where pressure increases the water's boiling point, allowing heat to penetrate quickly and kill microorganisms, including bacteria and viruses.

**Key Aspects of the Autoclave Mechanism:**

**1. Principle:** The core mechanism is moist heat sterilization. Steam, under high pressure, transfers latent heat to the items, killing microbes by coagulating their structural proteins and enzymes.

**2. Pressure and Temperature Relationship:** Pressure and temperature are directly proportional; increasing pressure allows steam to reach temperatures exceeding .

**Sterilization Stages:**

**1.Purging (Air Removal):** Steam enters the chamber, forcing out cold air through a discharge tap or vacuum pump. This is critical as air prevents effective sterilization.

**2.Sterilization (Holding Time):** The chamber is sealed and maintained at high pressure (typically 15-30 PSI) and temperature (usually 121-134°C) for a set time, typically 15-60 minutes.

**3.Exhaust:** Steam is released from the chamber, and the pressure returns to atmospheric pressure.



Scanned with OKEN Scanner

### 3. UV Spectrophotometer:


**Company:** SYSTRONICS

**Mechanism**: A UV-Vis spectrophotometer measures how much light a chemical substance absorbs by passing ultraviolet/visible light ( 190 -900nm) through a sample. It works by emitting light, selecting a specific wavelength via a monochromator, passing it through a sample in a cuvette, and detecting the transmitted light to calculate absorbance based on the Beer-Lambert Law (A = εbc).

**Key Components & Working Steps**

**Light Source:** A deuterium lamp (for UV) and a tungsten lamp (for visible) emit light.

**Monochromator:** Splits light into components (using a prism or grating) and isolates a specific wavelength.

**Sample Holder (Cuvette)**: Holds the sample, usually in quartz for UV measurements to avoid absorption by the container.

**Detector**: Measures the intensity of light that passes through the sample and converts it into an electrical signal.

**Data Processing**: The detector compares the light intensity through the sample (I) with a blank (I0) to calculate transmittance and absorbance.

**Key Principles**

**Beer-Lambert Law:** The core principle that states absorbance (A) is directly proportional to the concentration (c) of the sample and the path length (b) of light (A = εbc).

**Electronic Transition:** When atoms/molecules absorb UV/V is light, their electrons jump from a ground state to a higher energy level.

**Double Beam vs. Single Beam:** Double-beam instruments split the light beam to measure a reference (blank) and a sample simultaneously, improving stability.

**Typical Applications**

**Quantitative Analysis:** Determining the concentration of molecules like DNA, proteins, or pharmaceutical products.

**Qualitative Analysis:** Identifying substances by their unique absorption spectra.



Scanned with OKEN Scanner

## 4. Rotating Shaker :

**Company:** RS-24 PLUS REMI

**Mechanism**: A rotary shaker operates by using a motorized eccentric drive mechanism to generate uniform, horizontal circular (orbital) motion, typically at speeds of 20–300 RPM. A motor rotates a ball-bearing crankshaft, creating a consistent orbit that creates a vortex in liquids, fostering aeration and homogeneous mixing in laboratory vessels.

**Key Mechanisms and Components:**

**Motor Driven**: A powerful motor (often DC or brushless induction) drives the system.

**Eccentric Drive Mechanism:** The core is an eccentric bearing system, often triple-eccentric, designed to convert rotational motion into a smooth orbital shaking motion.

**Orbital Action:** The platform moves in a circle in a horizontal plane, causing liquid in containers to form a vortex, which aids in oxygen transfer and mixing.

**Speed & Time Control:** Digital or analog controls adjust RPM (speed) and time (minutes or hours) for precise, repeatable shaking, often with an LCD display.

**Counterbalanced Drive**: To prevent vibrations and instability, particularly at high speeds, a counterbalanced mechanism is used.

**Platform & Clamps:** The top platform is fitted with clamps or mats to securely hold flasks, tubes, or beakers in place while shaking.

**Common Applications:**

**Microbiology**: Culturing microorganisms (bacteria, yeast, fungi) by accelerating oxygen transfer.

**Biochemistry/Biotechnology:** Cell suspension and culture maintenance.

**Chemical Synthesis:** Mixing reagents in chemical reactions.

**Environmental Science:** Soil or water sample extraction processes.

These shakers are designed for continuous, long-term operation with minimal maintenance, often used inside incubators to maintain specific environmental conditions.



Scanned with OKEN Scanner

5. **Incubator:**


**Type:** Laboratory Incubator

**Company:** BIO- TECHNICS INDIA

**Mechanism:** An incubator operates on the principle of providing an isolated, controlled environment—optimized for temperature, humidity, and gas composition (like CO2 or CO2)—to faster the growth, cultivation, or development of microorganisms, cells, or biological samples. It uses a thermostat-regulated heating system, often with air circulation, to maintain stable, specific conditions.

**Key Working Principles of Incubators:**

**Controlled Environment:** Incubators maintain a precise, stable environment (temperature, humidity, and air composition) essential for microbial or cell culture development.

**Thermoelectric Effect/Thermal Control:** A thermostat and heating elements manage the internal temperature, providing a consistent thermal gradient for growth.

**Uniformity:** Internal fans and air circulation ensure an uniform temperature throughout the chamber to avoid cold or hot spots.

**Insulation:** The insulated chamber minimizes heat loss and protects samples from external environmental fluctuations.

**Specialized Parameters ( CO2):** In incubators, is introduced to dissolve into the medium, regulating the pH of the cell cultures through a bicarbonate buffer system.

**Mechanical Agitation (Shaker):** Incubator shakers provide movement to increase oxygen supply and nutrient distribution to the cultured cells.

**Types and Applications:**

**Laboratory Incubator:** General use for growing microorganism cultures.

**Incubator:** Essential for mammalian cell culture studies.

**BOD Incubator:** Specifically for Biochemical Oxygen Demand tests.

**Infant Incubator:** Used in hospitals for newborns requiring specific environmental control.



Scanned with OKEN Scanner

## 6. Hot Air Oven:


**Company:** BIO – TECHNICS INDIA

**Mechanism:** A hot air oven operates on the principle of dry heat sterilization, using high-temperature air (typically 160C to 250C) to destroy microorganisms through oxidation and protein denaturation. It utilizes electric heating elements and forced-air convection to distribute heat evenly, oxidizing bacterial cells and drying materials like glassware, metal instruments, and powders.

**Key Principles and Working Mechanism:**

**Dry Heat Sterilization:** Unlike autoclaves that use steam, hot air ovens use dry heat. This method kills microorganisms by oxidizing their cell components, causing protein denaturation, and dehydrating the cells.

**Convection and Conduction:** Heating elements heat the air, and fans circulate this hot air within the chamber (convection). The heat then passes from the air to the surface of the items and inwards (conduction).

**Uniform Heat Distribution:** A fan ensures uniform temperature distribution, preventing cold spots, which is crucial for achieving consistent sterilization.

**Double-Walled Insulation:** The oven is double-walled, with insulation in between, ensuring that heat remains inside the chamber for energy efficiency and consistent high temperatures.

**Common Operating Parameters:**

160C for 2 hours

170C for 1 hour

180C for 30 minutes

The process concludes with a cooling phase before opening to prevent breakage of glass items due to thermal shock.



Scanned with OKEN Scanner

## 7. Refrigerator:


**Company:** Samsung

**Mechanism:** Laboratory refrigerator operates on the principle of the vapor-compression refrigeration cycle, which removes heat from the interior chamber and releases it into the surrounding environment, maintaining a precise, low-temperature, and stable environment for sensitive samples, reagents, and pharmaceuticals. Unlike domestic refrigerators, lab units are engineered for high temperature uniformity (often 2°C to 8°C), rapid recovery after door openings, and include alarms for temperature deviations.

**Key Components of a Laboratory Refrigerator**

**Compressor:** Known as the "heart" of the system, it compresses the refrigerant gas, raising its pressure and temperature.

**Condenser:** Located outside the cooling chamber, this set of coils receives the hot gas and releases heat into the air, causing the refrigerant to condense into a liquid.

**Expansion Valve/Capillary Tube:** A narrow tube that reduces the pressure of the liquid refrigerant, causing it to cool significantly.

**Evaporator:** Located inside the unit, this coil allows the cold, low-pressure refrigerant to absorb heat from the storage area, causing it to evaporate back into a gas.

**Forced Air Circulation Fans:** Fans distribute cold air throughout the unit to ensure uniform temperature, often shutting off when the door is opened to prevent loss of cold air.

**Microprocessor Controller:** Monitors the internal temperature and manages alarms.

**General Purpose Laboratory Freezers/Fridges:** For daily storage of reagents.

**Chromatography Refrigerators:** Designed to store, protect, and provide power for chromatography systems inside the unit.

**Blood Bank Refrigerators:** Specifically calibrated for storing blood products at 2°C to 6°C.

**Ultra-Low Temperature (ULT) Freezers:** Capable of reaching -40°C to -86°C for long-term storage of biological samples, often using cascade refrigeration systems.



Scanned with OKEN Scanner

## 8. Weighing Balance:


**Company:**

**Mechanism:** A weighing balance operates primarily on the principle of electromagnetic force restoration (EMFR), where an electronic sensor detects the load applied to a pan and generates a counteracting magnetic force to keep the balance at a zero position. The current required to generate this balancing force is directly proportional to the sample's mass, which is then displayed digitally.

**Core Principles & Mechanisms**

**Electromagnetic Force Restoration (Electronic Balances)**: A load placed on the pan breaks the balance's equilibrium. An electromagnetic coil generates an opposing force to restore the equilibrium. The electrical current needed for this is directly proportional to the weight (mass*gravity).

**Load Cell/Strain Gauge (Precision Balances):** In some balances, the weight causes a sensor (load cell) to deform. This mechanical deformation is converted into an electrical signal proportional to the weight.

**Mechanical Principle (Beam Balance):** Compares the gravitational force of an unknown mass against a known mass, acting on a lever.

**Key Factors Affecting Measurements**

**Calibration:** Regular calibration is needed to maintain accuracy.

**Environmental Stability:** External factors like drafts, vibrations, and temperature variations can affect results.

**Static Electricity:** Can make the measurement unstable.

For high accuracy in scientific laboratories, these balances must be placed on stable platforms in controlled environments.



Scanned with OKEN Scanner

## 9. Microscope:


**Company: LYNX**

**Mechanism**: A microscope works by using lenses to refract (bend) light or electron beams, magnifying small specimens that are invisible to the naked eye. A compound light microscope uses two sets of lenses—the objective lens (closest to the specimen) and the eyepiece (closest to the eye)—to produce a large, inverted, virtual image.

**How a Compound Light Microscope Works:**

**Illumination:** Light from a source (mirror or electric bulb) passes through a condenser lens, which focuses light onto the specimen.

**Objective Lens Magnification**: The light travels through the specimen and into the objective lens, forming a magnified real image inside the microscope tube.

**Eyepiece Magnification:** The image is further magnified by the eyepiece (ocular) lens, creating a virtual image that your eye sees.

**Focusing:** Coarse and fine adjustment knobs move the stage or tube to bring the image into sharp focus.

**Key Principles:**

**Total Magnification:** Calculated by multiplying the objective lens magnification (e.g., 40x) by the eyepiece magnification (e.g., 10x), resulting in a 400x total magnification.

**Resolution:** The ability to distinguish fine details, often enhanced by using shorter wavelengths of light or high-quality lenses.

**Contrast:** The difference in brightness between the light and dark areas of an image, which can be adjusted with the diaphragm.

Different types of microscopes serve different purposes, such as stereo microscopes for 3D viewing and electron microscopes for extremely high resolution.



Scanned with OKEN Scanner

# BASIC MICROBIOLOGY

**What is Culture Media?**

The media is a source of nutrients to support the growth of the micro-organisms in-vitro. The media helps in the growth and counting of microbial cells, selection of microorganisms, and survival of microorganisms. The culture medium can be liquid or gel.

**Common ingredients of culture media**

* **Peptone-** source of carbon and nitrogen.

* **Beef extract-** source of amino acid, vitamins, minerals.

* **Yeast extract-** source of vitamin, carbon, nitrogen. Distilled water

* **Agar-** solidifying agent.

*** How to prepare culture media?**

1) Weigh the amount of ingredients powder on weighing machine.

2) Dissolve the ingredients in distilled water.

3) Adjust PH of the medium if needed.

4) Add agar and boiled it to dissolve.

5) Pour the media into flask.

6) Autoclave the media when ingredients fully dissolve.

7) Sterilization is done in autoclave to prevent from contamination, at 121°C for 15 min at 15lbs.

8) After the autoclave place the media flask in laminar air flow.

9) Sterilize the laminar air flow with 70% alcohol.

10) A bit cools down the media and pours into sterile Petri-plates for solidification.

11) Then sample is ready to spread(spreader) / streak

(Inoculation loop) on the medium for identification or isolation of microbes.

12) Sealed the Petri plates with paraffin, label them.

13) Keep them inverted in incubator at 37°C for 24hrs.

14) Observe the result next day colonies formation is visible on the media.

Scanned with OKEN Scanner

* Culture media are classified based on consistency (agar concentration) into solid, semi-solid, and liquid (broth) types, designed to grow, transport, or identify microorganisms. They are essential for studying bacterial motility, isolating pure cultures, and cultivating bacteria for laboratory analysis.

**1) Classification Based on Consistency**

Culture media are classified based on their physical state or consistency into three main types based on the amount of agar used:

**1) Solid Media**

**2) Semi-solid Media**

**3) Liquid Media (Broths)**

**2) Solid Media**

**Definition:** These contain a high concentration of agar (1.5% - 3.0%), which makes them solid at room temperature and allows them to remain solid at incubation temperatures (37°c), providing a rigid surface for bacterial growth.

* **Purpose:** Primarily used for the isolation of pure cultures, study of colony morphology, and enumeration of bacteria.

* **Examples:**

Nutrient Agar (NA): A general-purpose medium.

Blood Agar: Enriched medium to grow fastidious bacteria.

MacConkey Agar: Selective and differential medium.

**3) Semi-solid Media**

* **Definition:** These contain a low concentration of agar (0.2% - 0.5%), resulting in a jelly-like or soft consistency.

* **Purpose:** Primarily used to determine bacterial motility and for the cultivation of microaerophilic bacteria.

* **Examples:**

Motility Test Medium: Used to see if bacteria can move away from the inoculation stab line.

Stuart's Medium: A transport medium.

Hugh and Leifson's Oxidative-Fermentative Medium: Used to study sugar metabolism.

**4) Liquid Media (Broths)**



Scanned with OKEN Scanner

* **Definition:** These media contain no agar, resulting in a liquid consistency, and are often referred to as "broths".

* **Purpose:** Used for the rapid growth and cultivation of large volumes of bacteria (propagation).

* **Examples:**

Nutrient Broth: A common basal broth.

Tryptic Soy Broth (TSB): Used for growing wide varieties of microorganisms.

Selenite F Broth: An enrichment medium used for identifying pathogens.

**Application of culture media**

* To culture microbes.

* To identify the cause of infection.

* To identify characteristics of microorganisms.

* To isolate pure culture.

* To store the culture stock.

* To observe biochemical reactions.

* To test microbial contamination in any sample.

* To check antimicrobial agents and preservatives effect.

* To observe microbe colony type, its color, shape, cause.

* To differentiate between different colonies.

* To create antigens for laboratory use.

* To estimate viable count.

* To test antibiotic sensitivity.

**Inoculation method for bacterial population -**

For inoculation purposes, inoculating loop are used. Wire loops are sterilized using red heat in a Bunsen burner flame before and after use. They must be heated to red hot to make sure that any contaminating bacterial spores are destroyed. The handle of the wire loop is like a pen for holding it.



Scanned with OKEN Scanner

**Streak Plate Method –**


Streak Plate Method is employed for the isolation of bacteria in pure culture. In this technique, a sterilized inoculating loop or transfer needle is dipped into bacterial culture which is then streaked on the surface of an already solidified agar plate to make a series of parallel, non-overlapping streaks. The process is known as streaking and the plate so prepared is called a streak plate. The main objective of the streak plate method is to separate the colonies of bacteria from concentrated suspensions of cells. For inoculation, inoculating needle with a loop made up of either platinum or nichrome wire, is used for streaking.

One loopful of specimen is taken from the bacterial culture. The culture is transferred onto the surface of the agar plate in a sterile petri dish and streaked across the surface in the form of a zig-zag line. This process is repeated thrice to streak out the bacteria on the agar surface for the separation of individual bacteria colony. After incubation of 24 hours, the first streak will contain a thick layer of microorganisms than the second streaking. Similarly, the second streaking should be more thick than the third and so on.



Scanned with OKEN Scanner

**Bacterial Identification by simple staining procedure**

**Principle -**

In simple staining, bacterial smear is stained with a single type of staining reagent, which produces a distinctive contrast between the organism and its background. A simple stain that stains the bacteria is the direct stain. The purpose of simple staining technique is to determine cell shape, size arrangement of bacterial cells. In simple staining, basic stains are used which different exposure time (Crystal Violet 20-60 s, Carbol fuschin 15-30 s and Methylene blue 1-2 minutes).

**Procedure :**

1. Clean glass slide was taken and was washed and dried.
2. Bacterial smears were prepared from the bacterial cultures.
3. Put the slide with the fixed smear uppermost on a staining rack over a sink or staining tray.
4. Add few drops of stain and leave for 30 seconds. Pour off extra stain.
5. Hold the slide with forceps at a 45°angle over the sink wash the slide gently under slow running tap water.
6. Dry the slide using blotting paper.
7. Examine the slide under 10X, 45X and oil immersions objects respectively.

**Observation:**

**Gram Positive Rod**



Scanned with OKEN Scanner

**Colony Characters:**

| Sr. No. | Characteristic | Observation |
|---|---|---|
| 1 | Medium | Nutrient broth |
| 2 | Size | 1 mm / 0.8 mm |
| 3 | Shape | Circular |
| 4 | Margin | Entire, Smooth |
| 5 | Colour | Off-white |
| 6 | Elevation | Concave |
| 7 | Consistency | Sticky (Moist) |
| 8 | Texture | Smooth, Shiny |

**Result:**

Gram staining shows Gram-positive rod-shaped bacteria arranged in chains, suggesting streptobacilli (likely Bacillus species).



Scanned with OKEN Scanner

# Isolation of PGPR bacteria and its applications

## Optimization of PGPR Traits Using Specific Media (Mechanism + Results)

### 1. Nitrogen Fixation (Jensen's Medium)

**Principle of Medium**

Jensen's medium is a nitrogen-free medium designed to selectively allow growth of nitrogen-fixing bacteria.

**Mechanism**

Only bacteria capable of fixing atmospheric nitrogen ($N_2$) can grow.

These bacteria use the nitrogenase enzyme complex to convert $N_2 \rightarrow NH_3$.

N_2 + 8H^+ + 8e^- + 16ATP → 2NH_3 + H_2

Ammonia is assimilated into amino acids via GS-GOGAT pathway.

**Observed Results**

Growth on Jensen's agar (colonies visible)

No growth indicates absence of nitrogen-fixing ability

**Interpretation**

Positive isolate: Able to fix atmospheric nitrogen

Negative isolate: Requires external nitrogen source

Optimization outcome: Best growth observed at specific pH, temperature, and incubation time indicates maximum nitrogenase activity.

### 2. Phosphate Solubilization (Pikovskaya's Medium)

**Principle of Medium**

Contains insoluble phosphate (e.g., tricalcium phosphate – $Ca_3(PO_4)_2$).

**Mechanism**

PGPR solubilize phosphate by:

**1. Organic acid production (main mechanism)**

Gluconic acid, citric acid

Lowers pH



Scanned with OKEN Scanner

**2. Chelation**

Organic acids bind $Ca^{2+}$ → release $PO_4^{3-}$

Ca_3(PO_4)_2 → Soluble PO_4^{3-}

**Observed Results**

Clear halo zone around colony

**Interpretation**

Halo formation = phosphate solubilization

Larger halo = higher efficiency

**Optimization outcome:** Maximum halo diameter under optimized conditions indicates high acid production and solubilization efficiency.

**3. Potassium Solubilization (Aleksandrov Medium)**

**Principle of Medium**

Contains insoluble potassium sources like feldspar or mica.

**Mechanism**

PGPR release potassium via:

Organic acids

Proton ($H^+$) extrusion

Polysaccharide production

These lead to:

Mineral breakdown

Release of $K^+$ ions

**Observed Results**

Clear zone around colony

**Interpretation**

Zone formation = potassium solubilization

Larger zone = higher K-releasing ability



Scanned with OKEN Scanner

**Optimization outcome:** Best conditions enhance mineral dissolution and $K^+$ availability.

**4. Siderophore Production (CAS Medium)**

**Principle of Medium**

CAS (Chrome Azurol S) forms a blue complex with $Fe^{3+}$.

**Mechanism**

Under iron-limited conditions, bacteria produce siderophores

These chelate $Fe^{3+}$ and remove it from CAS dye complex

**Result:**

Color change due to Fe removal

**Observed Results**

Blue → Orange/Yellow zone around colony

**Interpretation**

Color change = siderophore production

Intensity/zone size = amount of siderophore

**Optimization outcome:** Maximum color change indicates high iron-chelating capacity, useful for plant growth and pathogen suppression.

**5. IAA Production (Tryptophan Broth + Salkowski Reagent)**

**Principle**

Tryptophan acts as a precursor for IAA synthesis.

**Mechanism**

Tryptophan-dependent pathway:

1. Tryptophan → Indole-3-pyruvic acid

2. → Indole-3-acetaldehyde

3. → Indole-3-acetic acid (IAA)

**Detection Reaction**

IAA reacts with Salkowski reagent

Produces pink to reddish color



Scanned with OKEN Scanner

**Observed Results**

Development of pink color

Interpretation

Light pink = low IAA

Dark pink/red = high IAA production

**Optimization outcome:** Maximum color intensity under optimized conditions indicates high auxin production, enhancing root growth.

**Final Integrated Result (Important for Conclusion Writing)**

All isolates were screened and optimized for PGPR traits using selective media:

Growth in Jensen's medium confirmed nitrogen fixation ability

Halo zone in Pikovskaya's medium indicated phosphate solubilization

Clear zone in Aleksandrov medium showed potassium solubilization

Color change in CAS medium confirmed siderophore production

Pink coloration in tryptophan broth with Salkowski reagent indicated IAA production

**Overall Interpretation**

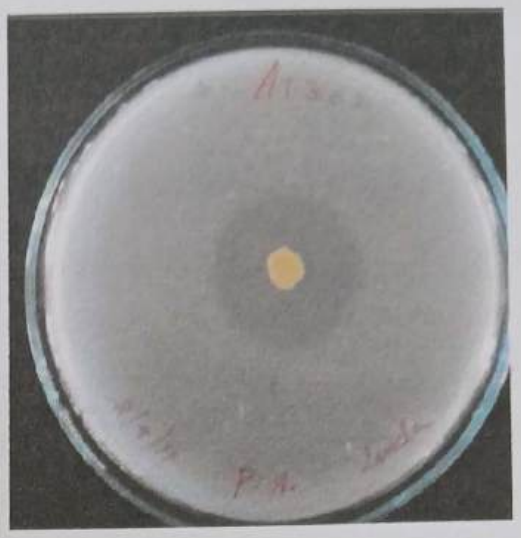
The isolate showing maximum activity in all assays under optimized conditions can be considered a potential multifunctional PGPR strain for biofertilizer application.



Scanned with OKEN Scanner

**Nitrogen Fixing Ability**

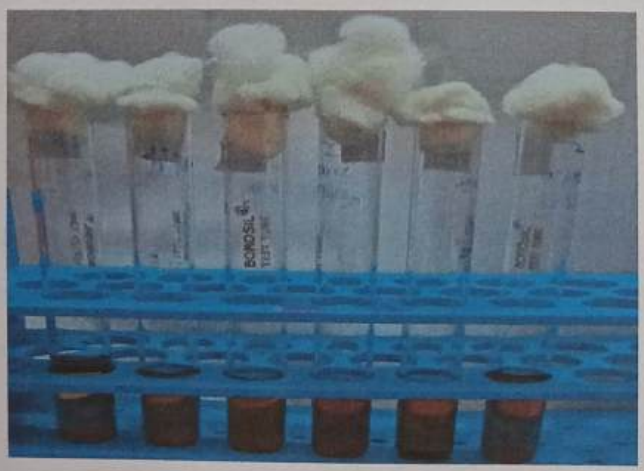
**Potassium Solubilizing Ability**



**Phosphorus Solubilizing Ability**

**Siderophores Activity**

**IAA Test**





Scanned with OKEN Scanner

# Biofertilizers, Production, Process and its advantages

**What is Biofertilizer?**

Biofertilizers are substance that contains microbes, which helps in promoting the growth of plants and trees by increasing the supply of essential nutrients to the plants. It comprises living organisms which include mycorrhizal fungi, blue-green algae, and bacteria. Biofertilizers are well known for their cost effectiveness, environment-friendly nature, and composition (Debmalya Dasgupta et al. 2021). These are effective alternatives to the hazardous synthetic fertilizers. Based on various functions, there are many types of biofertilizers as following.

**1. Nitrogen Fixers:-**Plants are not capable of using atmospheric nitrogen in its original form. For that microbes present in a soil provide atmospheric nitrogen to the plant through 'nitrogen fixation'. Nitrogen fixation is the process by which nitrogen is taken from its molecular form (N2) in the atmosphere and converted into nitrogen compounds useful for other biochemical process of plants (Hanrahan and Chan, 2005). Nitrogen fixing microbes can be symbiotic and non-symbiotic.

**Symbiotic:-** Symbiotic microbes fix the atmospheric nitrogen in association with another living organisms like algae, flowering plants, ferns etc. Some examples of symbiotic microbes are *Rhizobium, Bradyrhizobium, Azolla* etc.

**Non symbiotic :-** These are free living microbes which takes part in nitrogen fixation. Some examples of non symbiotic microbes are *Azotobacter, Acetobacter*, blue green algae, *Anabaena* etc.

**2. Phosphate Solubilizers:-** This involves bacteria releasing organic acids into the soil which solubilize phosphate complexes converting them into ortho-phosphate which is available for plant up-take and utilization (Nicholas Oteino et al. 2015.). Some examples of phosphate solubilizers are *Penicillium sp., Aspergillus sp., Bacillus sp.* Etc.

**3. Phosphate Mobilizers:-** phosphate mobilizing microorganisms mobilize insoluble and fixed forms of phosphorus in the soil through solubilization and mineralization. Some examples of phosphate mobilizers are *Arbuscular mycorrhiza* (AM), *Glomus sp.*etc.

**4. Potassium Solubilizers:-** This type of microorganisms solubilize potassium bearing minerals and convert the insoluble potassium to soluble form of potassium available to plant uptake. Some examples of potassium solubilizers are *Bacillus mucilaginosus, Fraturia aurantia etc.*



Scanned with OKEN Scanner

**5. Silicate Solubilizers:-** These groups of bacteria produce silicase, an enzyme responsible for the conversion of silicates into soluble silica, making silica available for plant uptake. For example, *Bacillus sp.*

**6. Zinc Solubilizers:-**This type of microorganisms are capable of solubilizing inorganic zinc and make it available for plant consumption. It reduces the need of excessive zink fertilizers in the soil. Some examples of zinc solubilizers are *Pseudomonas sp.*, *Gluconacetobacter sp.* etc.

**7. PGPR (Plant growth-promoting rhizobacteria):-** These type of bacteria colonize plant roots, significantly increase soil fertility, promote plant growth and development and enhance crop yield. (Chieb, M., Gachomo, E.W. 2023). Some examples are *Azotobacter, Bacillus,* etc.

**8. Compost making microorganisms:-** This type of microorganisms play a significant role in breaking down organic matter quickly. During the process of composting microorganisms recycle matter into fresh soil. For example, *Aspergillus sp., Trichoderma sp.* etc.

Based on forms there are two types of biofertilizers as following,

**1. Carrier Based Biofertilizers:-** In a carrier based biofertilizers, carriers are a medium which carry microorganisms in sufficient amount and keep microorganisms viable in specified condition. Carriers can be peat, charcoal, clay, lignite. Some examples of carrier based biofertilizers are *Rhizobium*, *Azotobacter, Acetobacter* etc. This type of biofertilizers are cheaper, cost effective than liquid biofertilizers and they are easy to produce. Due to low shelf life, temperature sensitivity, low cell count and contamination producers are giving preference to the liquid biofertilizers.

**2. Liquid Biofertilizers:-** In this type of biofertilizers microbial broth(liquid media) mixed with cell protectants is directly applied to the plants without carriers. Various types of microorganisms are used as a biofertilizers in a liquid form. Liquid biofertilizers are easier to produce, temperature tolerant, contamination free with longer shelf life. Due to high cell count they are more effective than carrier based biofertilizers. *Rhizobium*, *Azotobacter, Acetobacter* etc. are used in a liquid form.



Scanned with OKEN Scanner

**Advantages of Biofertilizers**

- Biofertilizers are less expensive than chemical fertilizers.
- They increase the soil fertility rate without polluting the soil.
- They are eco-friendly.
- They contain mineral solubilizing microbes which provide minerals in a useful form for a plant metabolism.
- They increase carbon and nitrogen ratio of soil.
- Plants cannot use atmospheric nitrogen in its original form, for that microbes present in biofertilizers convert the atmospheric nitrogen in a useful form through the process of nitrogen fixation and make it available to the plants.
- They maintain soil texture, and structure of soil.
- They activate soil biologically with increasing beneficial microorganisms.
- They provide tolerance to the biotic and abiotic stresses.
- They provide growth promoting hormones and enzymes.
- They enhance the crop growth and yield.
- In an organic farming biofertilizers are one of the major inputs for a sustainable crop yield.
- They protect the plants from pathogens.



Scanned with OKEN Scanner

**Production Process of Biofertilizers**

**Collection of rhizosphere soil:-** For the production of biofertilizers, microbes are collected from soil present near the roots.

**Isolation of Microorganisms:-** Microorganisms from collected soil can be isolated by serial dilution method. Serial dilution is method of isolating microorganisms in which the concentration of soil in a water is reduced by continuous addition of water to dilute the soil water solution until it becomes transparent.

**Purification:-** A clear solution of soil water sample is inoculated onto the solid medium and placed in an incubator for incubation various media can be used as per requirement for the growth of organism. For example PDA (Potato Dextrose Agar) for fungal growth, nutrient agar for bacterial growth, etc. After proper growth of microbes, colonies of specific microorganisms are developed on slants for its multiplication.

**Mother culture:-** When a specific microorganism is multiplied on a particular media so that it can be used for further processing, it is called as a mother culture.

**Multiplication:-** Microbes from mother culture are multiplied in a broth(liquid media) called as broth culture. For a large-scale production of biofertilizers, fermentation process is used. In this process microorganisms from mother culture are transferred and multiplied in a specific media, and that microbes work as a fermenter.

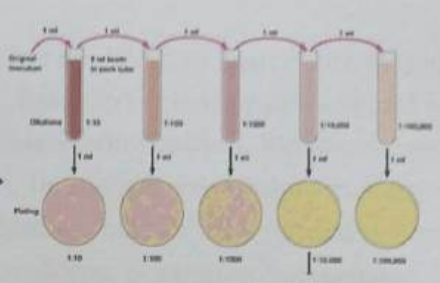
**Qualitative analysis:-** Qualitative analysis of biofertilizers includes gram staining, bacterial count methods etc.

**Packaging:-** For a liquid biofertilizers, broth culture can be directly packed and used as a liquid biofertilizers. For a preparation of solid biofertilizers, nutrient broth is mixed with charcoal powder, lignite, talcum, or pear.

Scanned with OKEN Scanner

# Production Process of Liquid Biofertilizers

Rhizosphere Soil



Serial Dilution

Inoculation

Purification

Broth Culture

Multiplication of Biofertilizer through Fermentation

Qualitative Analysis

Packaging



Scanned with OKEN Scanner

# Vermicomposting

Maximum consideration should be given to the recycling of agriculture organic waste. For organic waste fully utilised, it must be decomposed. Beneficial microorganisms and earthworms that naturally exist in the soil play an important role in this decomposition. Vermicomposting is process of decomposition of organic waste by earth worms. In this process earthworms digest the organic waste and convert it into fine granular compost called as 'humus'. It's natural organic fertilizer of good quality. Vermicompost contain nitrogen, phosphorus, potassium, manganese, iron, calcium, copper, boron, molybdenum, zinc, sulphur etc. Application of vermicomposting in organic farming can be a sustainable solution to conserve the nature and increase quality production from agriculture.

Earthworms are also called as farmer's friend. Earthworms used for a vermicomposting are generally 6 to 60 cm long. They are whitish or radish brown in colour. For vermicomposting *Eisenia fetida*, this species of earthworm is used. This type of earthworms can live for 2 to 3 years. 83,000 earthworms can be produce from 1000 earthworms in year. Earthworms can not live in water and dry soil. They require moist soil for their proper growth. There are mainly three types of methods of vermicomposting like shed method, bed method and tank method. In this vermicomposting experiment we followed tank method. For tank method mainly 25 feet long, 4 feet wide and 2 feet deep tank is used. But here, in our vermicomposting experiment we used plastic tank of 500 L capacity and kept it at shady place.

**Bed preparation:-** For vermicomposting, beds are prepared by using decomposed organic waste material like dry leaves, fruit waste, farm yard manure and soil. Different layers were given as follows. First a Layer of dried neem leaves was given. A layer of partially rotted mulch and sugarcane waste was given on it. Then a layer of partially decayed fruit waste was given. Before the layering of fruit waste, they were placed in 25 L tank with degrading bacteria (Surya-D) and left to decompose for one week. After that a layer of soil and dung was given and regular supply of water was given to keep the temperature balanced. Earthworms were released after 15 days after equilibration of substrate temperature..

**Observation and results:-** After 2-3 weeks black granular layer of organic manure will form.



Scanned with OKEN Scanner

**Precautions to be taken while vermicomposting:-**

1.Frog, snake, lizard, birds, chicken love to eat earthworms. In such case arrangement should be made to protect earthworms from it. Birds dig up the manure pile and eat the earthworms so shedding is important.

2.The temperature of the bed should not exceed 35°C.

3.When moving the layers, use light tool so as not to injure the earthworms.

4.Chemical fertilizers should not be added in vermicompost beds because earthworms are sensitive to the saline water and chemical fertilizers.

5.The vermi beds should be protected from insecticidal sprays.

6.The worms should be protected from ants, frogs, rats and birds.

7.For the pest control throw potato wedges over the bed, removing them after the pests have settled around them.

**How to use vermicompost:-**

The amount of vermicomposting depends on the amount of organic matter in the soil.

If the amount of organic carbon in the soil is above 0.6 %, 2 tons of vermicompost per acre per year should be used.

While preparing the soil, 30 % of the vermicompost should be mixed with the soil, before 8-10 days before planting seedlings or seeds.

40% of the amount of vermicompost should be given to the roots when the roots are strong in the soil.

30% amount of vermicompost should be given when a crop coming to flowering.

5 kg vermicompost should be distributed twice per year for orchards.



Scanned with OKEN Scanner

**Advantages of vermicompost:-**

Earthworms improve the soil texture.

Beneficial changes are made in the composition of soil particles.

Worm's excreta is an excellent type of fertilizer, called as a humus. Due to this, the phosphorus, potassium and other micronutrients required for the growth of the plant are easily available to the plants.

The land is cultivated naturally.

Water holding capacity of soil increases, evaporation rate of water also reduces.

It maintains the pH of soil.

Earthworms bring up the soil from the bottom layer and make it a good compost.

Increase the number of beneficial bacteria.

It increases the growth rate of plants and immune power against pests and diseases.

Vermicompost is mainly useful for food grains, vegetables and orchards.



Scanned with OKEN Scanner

# Layers For Vermicomposting

1. Neem leaves

2. Fruit waste

3. Sugarcane waste

4. Farmyard manure and soil

5. Mixture of earthworms

6. Earthworms



Scanned with OKEN Scanner

# SOIL TESTING

**Soil Report – Short Analysis & Suggestion**

The soil is highly alkaline (pH 9.6), which reduces nutrient availability to plants. Organic carbon is very low, indicating poor soil fertility and low microbial activity. Nitrogen and phosphorus are low, which can limit plant growth, while potassium, calcium, and magnesium are high, causing nutrient imbalance and making the soil hard.

**Simple suggestions for farmer:**

Add farmyard manure (FYM) or compost regularly to improve soil fertility

Grow green manure crop like Dhaincha and mix it into the soil

Use biofertilizers like Azospirillum and PSB

Avoid excess use of potash fertilizers

Improve drainage system to prevent water stagnation

These practices will help improve soil health, make it softer, and increase crop yield naturally .

**Soil Testing**

Soil testing was carried out using the Dr. Soil Kit, which is a rapid field-based testing method. The soil sample was collected from the field and analyzed for various parameters such as pH, electrical conductivity (EC), organic carbon, and major nutrients (N, P, K) along with micronutrients. The kit provides quick and reliable results, helping to understand the fertility status and nutrient availability of the soil. Based on the obtained results, the soil condition was evaluated and suitable recommendations were suggested for improving soil health and crop productivity.



Scanned with OKEN Scanner

# Soil Doctor

In Association with
**Shreel Surya Research Pvt Ltd.**

| Name: | Mobile: | Address: | City/State: |
|---|---|---|---|
| Bharat Kamble | 8999177076 | Takvade, lalitadevi mandir, Kolhapur, Maharashtra | Kolhapur, Maharashtra |

| Previous Crop: | Farm Size: | Next Crop: |
|---|---|---|
| Groundnut | 1.00 Acres | sugar cane |

| Farm Name: | Sample Code: | Treatment Type: | Date: |
|---|---|---|---|
| Lalita devi farm | SD008952 | - | 6 April 2026 |

## SECTION 1: SOIL ANALYSIS SUMMARY

*This is what we tested in your soil sample.*

| S. No. | Parameter | Ideal Range | Actual Value | Status |
|---|---|---|---|---|
| 1 | pH | 6.5 - 7.5 | 9.6029 | ● |
| 2 | EC (dS/m) | 1 - 3 | 0.51 | ● |
| 3 | Organic Carbon (%) | 0.5 - 0.75 % | 0.1% | ● |
| 4 | Soil Organic Matter (%) | 2.0 - 4.0 % | 0.17% | ● |
| 5 | Available Nitrogen | 280 - 560 kg/ha | 218.84 kg/ha | ● |
| 6 | Available Phosphorus | 10 - 25 kg/ha | 2.6 kg/ha | ● |
| 7 | Available Potassium | 110 - 280 kg/ha | 492.68 kg/ha | ● |
| 8 | Sulphur | 10 - 20 mg/kg | 51.24 mg/kg | ● |
| 9 | Magnesium | 180 - 540 ppm | 2278.93 ppm | ● |
| 10 | Calcium | 400 - 1200 ppm | 3968.34 ppm | ● |
| 11 | Zinc | 0.5 - 1.0 mg/kg | 0.63 mg/kg | ● |
| 12 | Iron | 5.0 - 10.0 mg/kg | 45.21 mg/kg | ● |
| 13 | Copper | 0.2 - 0.4 mg/kg | 3.926 mg/kg | ● |
| 14 | Boron | 0.1 - 0.5 mg/kg | 5.51 mg/kg | ● |

## DERIVED PARAMETERS

| S. No. | Parameter | Ideal Range | Actual Value | Status |
|---|---|---|---|---|
| 15 | C:N Ratio | 8:1-12:1 | 9.1:1 | ● |
| 16 | CEC Tendency | 10-20 | 39.47 cmol(+)/kg | ● |
| 17 | Ca:Mg Ratio | 5:1-7:1 | 1.7:1 | ● |
| 18 | K:Mg Ratio | 0.5:1-0.7:1 | 0.22:1 | ● |

Contact Us:
9561283147

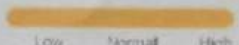
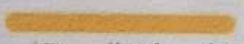
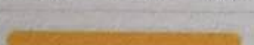
Email Us:
suryaagrobiotech@gmail.com



Scanned with OKEN Scanner

## SECTION 2: DETAILED NUTRIENT INSIGHTS

*Deep-dive into each tested parameter.*

| Parameter | Fertility Rating | What it means? | Function in Crop Growth |
|---|---|---|---|
| pH |  | Acidity/alkalinity of soil | Affects nutrient availability and microbial activity |
| EC (dS/m) |  | Salt level in soil | Influences root water uptake and nutrient solubility |
| OC (%) |  | Soil organic matter | Enhances microbial life, structure, and water retention |
| Nitrogen |  | Growth nutrient | Promotes leafy growth and chlorophyll formation |
| Phosphorus |  | Energy transfer | Supports root development and flowering |
| Potassium |  | Fruit quality regulator | Helps in water balance, disease resistance, fruit size |
| Sulphur |  | Protein synthesis | Improves enzyme function, oil synthesis, and taste |
| Magnesium |  | Core of chlorophyll | Essential for photosynthesis and enzyme activation |
| Calcium |  | Cell strength | Builds strong cell walls, prevents blossom-end rot |
| Zinc |  | Growth hormone support | Needed for enzyme activation, leaf expansion, rooting |
| Iron |  | Chlorophyll synthesis | Supports green leaf formation and respiration |
| Copper |  | Enzyme activator | Influences pollen viability and disease resistance |
| Boron |  | Pollination & fruit set | Aids flowering, fruit set, sugar transport, and seed formation |

Low Normal High

Contact Us:
9561283147

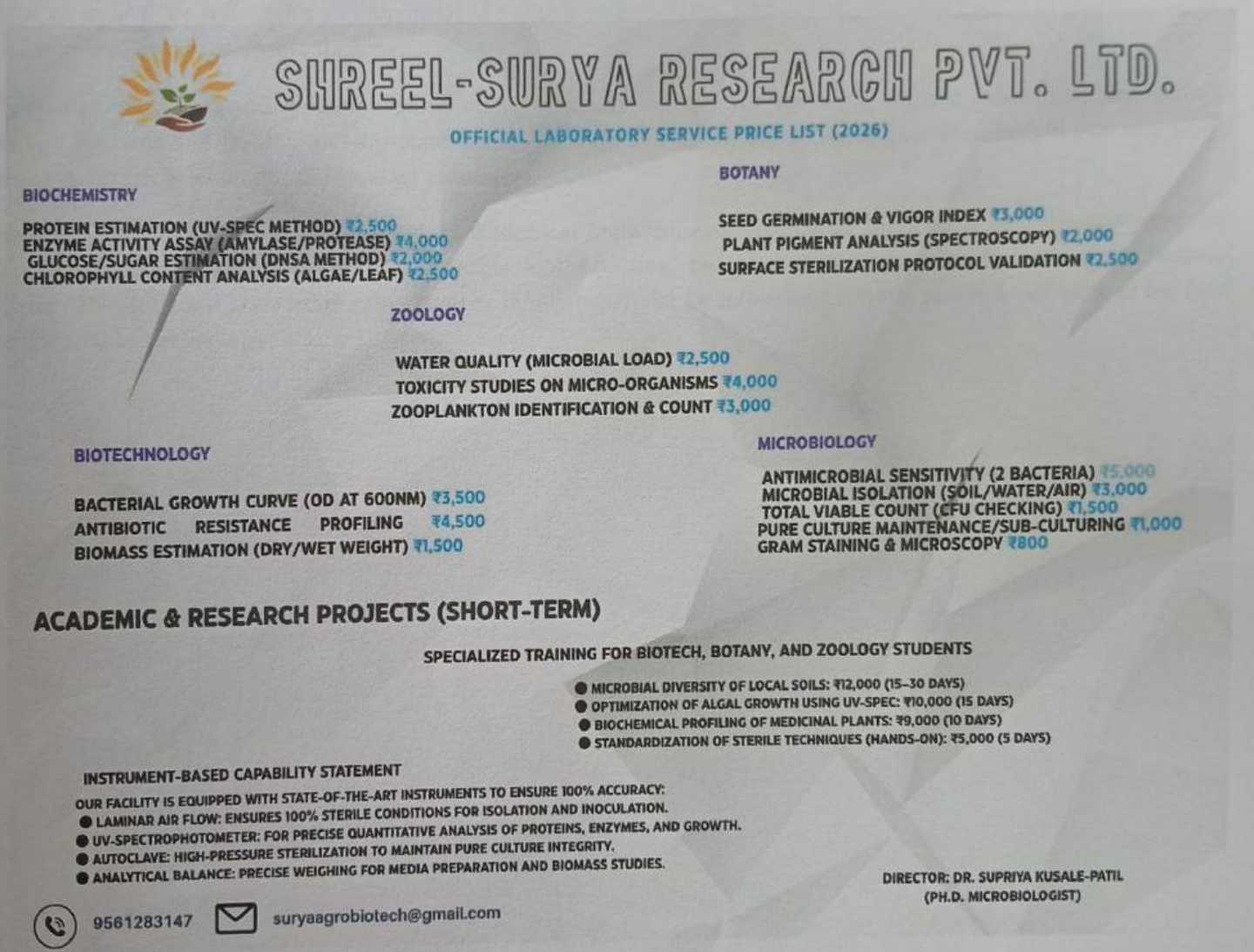
Email Us:
suryaagrobiotech@gmail.com



Scanned with OKEN Scanner

# MARKETING STRATEGIES

**Marketing:-** Under the guidance of Dr. Supriya Kusale we learned some marketing skills like taking feedbacks of customers through interviews as well as google forms. We also learned to design pamphlet for a products with the help of 'Canva' application.




**Pamphlet design for service provided by Shreel Surya Research Private limited, designed with the help of Canva application**



Scanned with OKEN Scanner

# CONCLUSION

The On Job Training on "Bio Innovations for Sustainable Agriculture" provided practical and scientific understanding of microbial-based agricultural technologies. Through hands-on experience, we successfully studied the isolation and screening of PGPR isolates and confirmed their functional traits such as nitrogen fixation, phosphate and potassium solubilization, siderophore production, and IAA production using selective media. These results indicate the potential of selected isolates as effective biofertilizer candidates.

The training also helped in understanding the complete production process of liquid and carrier-based biofertilizers, emphasizing the importance of microbial quality, sterility, and large-scale fermentation. Soil testing using the Dr. Soil Kit enabled us to analyze soil health and recommend suitable amendments, highlighting the importance of nutrient balance and organic matter in sustainable farming.

Additionally, vermicomposting demonstrated an eco-friendly method for recycling organic waste into nutrient-rich manure, improving soil fertility and structure. Field exposure and marketing activities provided insight into real-world application, farmer interaction, and product awareness.

Overall, this training bridged the gap between theoretical knowledge and industrial application, and demonstrated that biofertilizers and organic practices are sustainable, cost-effective, and environmentally safe alternatives to chemical fertilizers. The skills and knowledge gained will be highly beneficial for future research and professional work in the field of agricultural biotechnology.



Scanned with OKEN Scanner

# REFFERENCES


- Debmalya Dasgupta et al. Microbial biofertilizers: Recent trends and future outlook. Recent Advancement in Microbial Biotechnology , 2021.
- G. Hanrahan, G. Chan.Nitrogen,Encyclopedia of Analytical Science (Second edition) (2005)
- Rita Mahapatra et al. The molecular architecture of rhizobium–plant symbiosis in nitrogen fixation, The Chemical Dialogue Between Plants and Beneficial Microorganisms, 2023.
- Chieb, M., Gachomo, E.W. The role of plant growth promoting rhizobacteria in plant drought stress responses. *BMC Plant Biol* **23**, 407 (2023).
- Yusuf Chisti, Keikhosro Karimi, Bioethanol Production, Reference Module in Earth Systems and Environmental Sciences, 2022.
- Nicholas Oteino et al., Plant growth promotion induced by phosphate solubilizing endophytic Pseudomonas isolates, Front Microbiol. 2015.
- Sapna, D.P. Chaudhary, Ramesh Kumar, S. Mandhania, P. Srivastava, Aswani Kumar* and R. S.Kumar. Corn to Ethanol: Retrospect's and Prospects, Maize: Leading to a new Paradigm. Directorate of Maize Research, Pusa Campus, New Delhi -110 012 Technical Bulletin 2012/7 pp.28
- Shahabaldin Rezania et al. Ethanol Production from Water Hyacinth (Eichhornia crassipes) Using Various Types of Enhancers Based on the Consumable Sugars, Waste and Biomass Valorization · June 2018.
- K. Mishra *et al.*Production
  Mater. Today Proc.(2022)
- Braide W, Kanu I.A, Oranusi U.S and Adeleye S.A. Production of bioethanol from agricultural waste. J. Fundam. Appl. Sci., 2016, 8(2), 372-386.




Scanned with OKEN Scanner






Scanned with OKEN Scanner

# SHREEL-SURYA RESEARCH PVT LTD

**Registered Office:** H No. 46 E Ward 240/3 Kolhapur-416005, Maharashtra, India

**Contact:** +91-8830682996 | 9561283147 | 9372443536

**Email:** suryaagrobiotech@gmail.com |

**CIN:** U24290PN2022PTC213860

## Supervisor Evaluation of Intern

**Student Name:** Vaishanvi Vinod Abrang **Date:** 15/4/26
**Work Supervisor:** Ekata Hemant Kamble **Title:** Bio Innovation & Sustainable Agriculture
**Organization:** Shreel-Surya Research Pvt Ltd **Internship Address:**
Valivade, Kolhapur **Dates of Internship:** From
1/4/26 To 15/4/26

Please evaluate the intern by indicating the frequency with which you observed the following behaviors:

| Parameters | Needs Improvement | Satisfactory | Good | Excellent |
|---|---|---|---|---|
| **Behaviors** | | | | ✓ |
| Performs in a dependable manner | [ ] | [ ] | [ ] | [✓] |
| Cooperates with co-workers and supervisors | [ ] | [ ] | [✓] | [ ] |
| Shows interest in work | [ ] | [ ] | [✓] | [ ] |
| Learns quickly | [ ] | [ ] | [ ] | [✓] |
| Shows initiative | [ ] | [✓] | [ ] | [ ] |
| Produces high quality work | [ ] | [ ] | [ ] | [ ] |
| Accepts responsibility | [ ] | [ ] | [✓] | [ ] |
| Accepts criticism | [ ] | [ ] | [ ] | [ ] |
| Demonstrates organizational skills | [ ] | [ ] | [✓] | [ ] |
| Uses technical knowledge and expertise | [✓] | [ ] | [ ] | [ ] |
| Shows good judgment | [ ] | [✓] | [ ] | [ ] |
| Demonstrates | [ ] | [ ] | [✓] | [ ] |

Scanned with OKEN Scanner

| Parameters | Needs Improvement | Satisfactory | Good | Excellent |
|---|---|---|---|---|
| creativity/originality | | | ✓ | |
| Analyzes problems effectively | [ ] | [ ] | [ ] | [✓] |
| Is self-reliant | [ ] | [ ] | [ ] | [✓] |
| Communicates well | [ ] | [ ] | [ ] | [✓] |
| Writes effectively | [ ] | [✓] | [ ] | [ ] |
| Has a professional attitude | [ ] | [ ] | [✓] | [ ] |
| Gives a professional appearance | [ ] | [✓] | [ ] | [ ] |
| Is punctual | [✓] | [ ] | [ ] | [ ] |
| Uses time effectively | [ ] | [✓] | [ ] | [ ] |

**Overall performance of student intern (circle one):** (Needs Improvement / Satisfactory / Good / Excellent)

**Signature of Industry Supervisor** _____

Scanned with OKEN Scanner