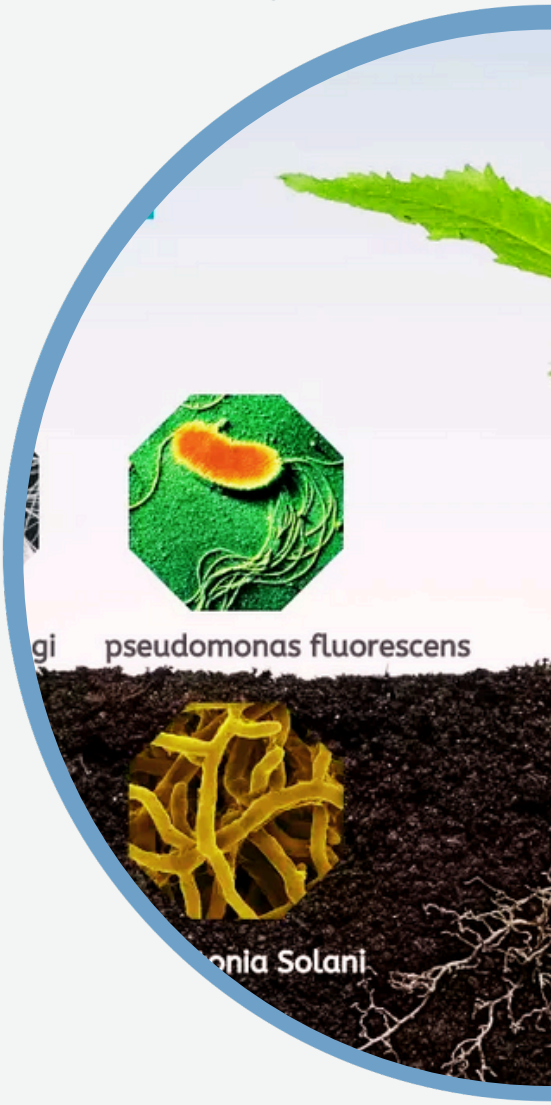
मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS ON

BIO-FERTILIZERS



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1. Introduction

Biofertilizers play a pivotal role in sustainable agriculture by enhancing soil fertility, promoting plant growth, and reducing dependence on chemical fertilizers. In recognition of their importance, the Bureau of Indian Standards has developed a comprehensive set of standards to ensure the quality, safety, and efficacy of biofertilizer products available in the Indian market.

The Indian Standards on biofertilizers serve as a crucial regulatory and technical framework for manufacturers, quality control laboratories, agricultural professionals, and policymakers. These standards specify the requirements for different categories of biofertilizers—such as *Rhizobium, Azotobacter, Azospirillum*, phosphate-solubilizing microorganisms (PSMs), and others—covering aspects like microbial count, shelf life, *p*H, moisture content, and packaging. They also include protocols for sampling and testing to verify product compliance and performance.

By providing clear guidelines and quality benchmarks, the Indian Standards help in maintaining consistency in product quality, safeguarding farmer interests, and supporting the broader goals of environmental conservation and food security. This compendium brings together all relevant standards on biofertilizers, offering a consolidated reference for stakeholders involved in the production, regulation, and application of these vital agricultural inputs.

2 IS 14806 : 2021 *Azospirillum* Inoculants – Specification (*first revision*)

2.1 Scope: This standard prescribes the requirements, method of sampling and tests for *Azospirillum* inoculants.

2.2 Uses: *Azospirillum* inoculants, which are biofertilizers containing bacteria that fix atmospheric nitrogen and promote plant growth, offer several benefits in agriculture. These include eco-friendly practices, nitrogen fixation, improved soil fertility, increased crop yield, and reduced chemical fertilizer use.

2.3 Requirements:

a) *Active Content:* The material shall contain minimum 5×10^7 CFU viable *Azospirillum* cells per gram of powder, granules or carrier material or per gram of gelatin capsule content.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms at 10^5 dilutions.
c) *pH:* The pH of the material shall be in range 5.0 to 7.0.
d) *Packaging:* It shall be packed in polyethylene packs, thickness which shall not be less than 75-100 micron.
e) *Storage:* It shall be stored by the manufacturer in a cool and dry place away from direct heat preferably at a temperature of 20 °C and not exceeding 30 °C. It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

2.4 Tests: The active content and other micro-organism in *Azospirillum* inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

3 IS 14807 : 2021 Phosphate Solubilizing Bacterial Inoculant (PSBI) - Specification (first revision)

3.1 Scope: This standard prescribes the requirements, method of sampling and tests for phosphate solubilizing bacterial inoculants.

3.2 Uses: The phosphate solubilizing bacterial inoculants (PSBI) include different groups of soil micro-organisms which convert insoluble phosphatic compounds into soluble form. The species of *Pseudomonas, Micrococcus, Bacillus, and Flavobacterium* are active in bioconversion. The most efficient bacterial isolates are identified as *Pseudomonas striata, Pseudomonas rathonis, and Bacillus polymyxa*. These efficient micro-organisms have shown capability to solubilize phosphorus content supplied through fertilizer application in the soil.

3.3 Requirements:

a) *Active Content:* The material shall have minimum 5×10^7 CFU viable Phosphate Solubilising Bacterial cells/g of the carrier material on dry mass basis.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms at 10^5 dilutions.
c) *pH:* The pH of the material shall be in range 6.5 to 7.5.
d) *Packaging:* It shall be packed in polyethylene packs, thickness of which shall not be less than 100 micron.
e) *Storage:* Phosphate solubilizing bacterial inoculants (PSBI) shall be stored by the manufacturer in a cool and dry place away from direct heat preferably at a temperature of

20 °C and not exceeding 30 °C. It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

3.4 Tests: The active content and other micro-organism in phosphate solubilizing bacterial inoculants (PSBI) are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

4 IS 15849 : 2009 Phosphate solubilizing fungal inoculants - *Aspergillus Awamori* – Specification

4.1 Scope: This standard prescribes the requirements and methods of sampling and tests for *Aspergillus Awamori* inoculants.

4.2 Uses: The phosphate solubilizing fungal inoculant *Aspergillus Awamori* includes a culture, which efficiently converts the insoluble inorganic phosphate compounds into soluble form.

4.3 Requirements:

a) *Active Content:* The material shall contain 10^8 viable fungal spores/g of the carrier material on dry mass basis.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms at 10^6 dilutions.
c) *pH:* The pH of the material shall be in range 6.5 to 7.5.
d) *Packaging:* It shall be packed in polyethylene packs, thickness of which shall not be less than 100 micron.
e) *Storage:* PSFI shall be stored by the manufacturer in cool and dry place away from direct heat preferably at a temperature of 20 °C and not exceeding 30 °C It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

4.4 Tests: The active content and other micro-organism in phosphate solubilizing fungal inoculant *Aspergillus Awamori* are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

5 IS 17134 : 2020 Biofertilizer - Liquid Based Rhizobium Inoculants - Specification

5.1 Scope: This standard prescribes the requirements and methods of sampling and test for liquid-based *Rhizobium* inoculants.

5.2 Uses: Bacteria of the genus Rhizobium (plural Rhizobia) form nodules on roots of certain leguminous plants and fix atomospheric nitrogen. These bacteria, although present in most soil types, vary in number and effectiveness in nodulation and nitrogen fixation, hence wherever necessary, seed inoculation is practised to ensure adequate population of effective strains of the required Rhizobia in the root zone so as to improve nodulation, nitrogen fixation, crop growth and yield of leguminous crops. Leguminous crops not only depend on nitrogen fixed biologically in root-nodules for their growth, but also may add considerable amount of nitrogen into soil for the benefit of a subsequent crop, which is one of the scientific basis in the agricultural practice of crop rotation. With suitable Rhizobium inoculation, leguminous crops can be raised successfully without resorting to large application of inorganic nitrogenous fertilizers, except for starter doses up to 20 kgN/ha.

5.3 Requirements:

a) *Active Content:* The material shall contain a minimum of 1×10^8 viable *Rhizobium* cells/ml of the liquid during the entire period of shelf-life from the date of manufacture.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms.
c) *pH:* The pH of the material shall be in range 6.5 to 7.5.
d) *Packaging: Rhizobium* inoculant (RI) shall be packed in packaging material of low-density polyethylene/polypropylene bags thickness of which shall be minimum 75 to 100 micron or in suitable HDPE/polypropylene/plastic/ glass bottles.
e) *Storage: Rhizobium* inoculant (RI) shall be stored by the manufacturer in a cool and dry place away from direct heat preferably at a temperature of 15°C to 30°C. It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

5.4 Tests: The active content and other micro-organism in liquid-based *Rhizobium* inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

6 IS 17135 : 2019 Biofertilizer - Liquid Based *Azotobacter spp.* Inoculants – Specification

6.1 Scope: This standard prescribes the requirements and methods of sampling and test for liquid based *Azotobacter spp.* inoculants.

6.2 Uses: *Azotobacter spp.* is a bacterium, which fixes atmospheric nitrogen non-symbiotically and may be used as an inoculant for non-leguminous plants. Besides fixing nitrogen, it produces antifungal metabolites and certain vitamins and growth promoting substances, which may increase seed germination and plant stand, and also improve the initial vigour of inoculated plants.

6.3 Requirements:

a) *Active Content:* The material shall contain a minimum of 1×10^8 viable *Azotobacter* cells/ml of the liquid during the entire period of shelf-life from the date of manufacture.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms.
c) *pH:* The pH of the material shall be in range 6.5 to 7.5.
d) *Packaging: Azotobacter spp.* Inoculant (AI) shall be packed in packaging material of low density polyethylene/ polypropylene bags thickness of which shall be minimum 75-100 micron or in suitable HDPE/ polypropylene/plastic/glass bottles.
e) *Storage: Azotobacter spp.* Inoculant (AI) shall be stored by the manufacturer in a cool and dry place away from direct sun or heat, preferably at a temperature of 15 to 30°C. It shall also be the duty of the manufacturer to instruct the retailers and in turn, the users about the precautions to be taken during storage.

6.4 Tests: The active content and other micro-organism in liquid based *Azotobacter spp.* inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

7 IS 17136 : 2019 Biofertilizer - Liquid Based Azospirillum Inoculants - Specification

7.1 Scope: This standard prescribes the requirements, method of sampling and tests for liquid based *Azospirillum* inoculants.

7.2 Uses: The bacteria of genus *Azospirillum* are gram negative, micro-aerophilic and fix nitrogen in the roots of many non-leguminous crops like cereals, millets, forage crops and vegetables. Besides fixing nitrogen, Azospirillum also produces growth promoting substances required for vegetative growth of the plants. These bacteria although present in most soil types, the number of *Azospirillum* and extent of the benefits varies in the soil.

7.3 Requirements:

a) *Active Content:* The material shall contain 1×10^8 viable Azospirillum cells/ml of liquid during the entire period of shelf-life from the date of manufacture.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms.
c) *pH:* The pH of the material shall be in range 6.5 to 7.5.
d) *Packaging: Azospirillum* inoculant (ASI) shall be packed in packaging material of low density polyethylene/ polypropylene bags thickness of which shall be minimum 75-100 micron or in suitable HDPE/ polypropylene/plastic/glass bottles.
e) *Storage: Azospirillum* inoculant (ASI) shall be stored by the manufacturer in a cool and dry place, away from direct heat preferably at a temperature of 20°C and not exceeding 30°C. It shall also be the duty of manufacturer to instruct retailers and in turn, users about precautions to be taken during storage.

7.4 Tests: The active content and other micro-organism in liquid based *Azospirillum* inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

8 IS 17137 : 2019 Biofertilizer - Liquid Based Phosphate Solubilizing Bacterial Inoculants (PSBI) - Specification

8.1 Scope: This standard prescribes the requirements, method of sampling and tests for liquid based phosphate solubilising bacterial inoculants.

8.2 Uses: The phosphate solubilising bacterial inoculants (PSBI) include different groups of soil micro-organisms which convert insoluble phosphatic compounds into soluble form. The species of *Pseudomonas, Micrococcus, Bacillus and Flavobacterium* are active in bioconversion. The most efficient bacterial isolates are identified as *Pseudomonas striata, Pseudomonas rathonis and Bacillus polymyxa*. These efficient micro-organisms have shown capability to solubilise phosphorus content supplied through fertilizer application in the soil.

8.3 Requirements:

a) *Active Content:* The material shall contain 1×10^8 viable Azospirillum cells/ml of liquid during the entire period of shelf-life from the date of manufacture.
b) *Other Microorganism:* It shall have no contamination with other Micro-organisms.
c) *pH:* The pH of the material shall be in range 5.0 to 7.5.
d) *Packaging:* PSBI shall be packed in packaging material of low density polyethylene/ polypropylene bags thickness of which shall be minimum 75-100 micron or in suitable HDPE/ polypropylene/plastic/glass bottles.

e) *Storage:* Phosphate solubilising bacterial inoculants (PSBI) shall be packed in packaging material of low density polyethylene/polypropylene bags, thickness of which shall not be less than 75-100 micron or in suitable HDPE/polypropylene/plastic/glass bottles.

8.4 Tests: The active content and other micro-organism in liquid based phosphate solubilising bacterial inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

9 IS 17672 : 2021 Potash Mobilizing Bacterial Inoculant (KMBI) — Specification

9.1 Scope: This standard prescribes the requirements, method of sampling and tests for potash mobilizing bacterial inoculants.

9.2 Uses: The potash mobilizing bacterial inoculants (KMBI) include different groups of soil micro-organisms which release immobilized potassium compounds into available form. The species of *Bacillus, Pseudomonas and Fraturia* are active in bioconversion. The most efficient bacterial isolates are identified as *Fraturia aurantia, Bacillus edaphicus and Bacillus muscilaginosus*. These efficient micro-organisms have shown capability to mobilize potash content available in soil naturally or applied in the soil through fertilizer application. Use of KMBI releases some of the gorged potassium between the layers of clay. Therefore, KMBI increase potassium availability in soils besides increasing mineral contents in plants. The potassium mobilizing bacteria is gram negative rod type bacteria, can grow in pH 3.5 to 11 and capable of mobilizing the mineral potash to the tune of 40-60 kg/ha.

9.3 Requirements:

a) **Active Content:** The material shall contain minimum 5×10^7 viable potassium mobilizing bacterial cells per gram of powder, granules or carrier material or per gram of gelatin capsule content during the entire period of shelf-life from the date of manufacture, as specified on the packet.
b) **Other Microorganism:** It shall have no contamination with other Micro-organisms at 10^5 dilutions.
c) **pH:** The pH of the material shall be in range 5.0 to 7.5.
d) **Packaging:** KMBI shall be packed in packaging material of low density polyethylene/ polypropylene bags thickness of which shall be minimum 75-100 micron or in suitable HDPE/ polypropylene/plastic/glass bottles.
e) **Storage:** KMBI shall be stored by the manufacturer in a cool and dry place away from direct heat preferably at a temperature of 20 °C and not exceeding 30 °C. It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

9.4 Tests: The active content and other micro-organism in potash mobilizing bacterial inoculants are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.

10 IS 17755 : 2022 Consortia of Microbial Inoculants (Mixed Biofertilizer Inoculants) — Specification

10.1 Scope: The standard prescribes the requirements, method of sampling and tests for Consortia of Microbial Inoculants (CMI).

10.2 Uses: The Consortia of Microbial Inoculants (CMI) include different groups of beneficial soil micro-organisms, such as nitrogen fixers, phosphate solubilizers, potash mobilizers, zinc solubilizers and plant growth promoters which harvest the nutrients in unavailable form from the air and soil and convert them into plant usable form. Some bacteria secrete growth promoting hormones and help in plant growth and root development through their hormonal action. The species of Rhizobium, Azotobacter, Azospirillum, Bacillus, Pseudomonas, Fraturia, Gluconacetobacter, Pseudomonas fluorescens etc. are active in such bioconversion. These efficient micro-organisms have shown capability to mobilize nitrogen, phosphorus, potassium and zinc content available in the soil as natural reserve or supplied through fertilizer application in the soil.

10.3 Requirements:

1. Active Content: The material shall contain a minimum of 1×10^6 viable cells of each of the constituent microorganism individually, per gram of the carrier material on dry mass basis during the entire period of shelf life, as specified on the packet.

2. Other Microorganism: It shall have no contamination with other Micro-organisms at 10^5 dilutions.

3. pH: The pH of the material shall be in range 5.0 to 7.5.

4. Packaging: CMI shall be packed in packaging material of low density polyethylene or polypropylene bags thickness of which shall not be less than 75 micron or in suitable HDPE or polypropylene or plastic or glass bottles.

5. Storage: CMI shall be stored by the manufacturer in a cool and dry place away from direct heat preferably at a temperature of 20 °C and not exceeding 30 °C. It shall also be the duty of the manufacturer to instruct the retailers and, in turn, the users about the precautions to be taken during storage.

10.4 Tests: The active content and other micro-organism in Consortia of Microbial Inoculants (CMI) are determined by serial dilution method; and pH is determined by instrumental method where pH meter is used.