






## Khet Bachao Abhiyan Series: ICAR RCER, Patna

### ICAR-Research Complex for Eastern Region, Patna

#### No-12: Phosphatic Biofertilizers for Better Yields

##### Importance of Phosphatic Fertilizers

Phosphorus (P) is one of the three major plant nutrients, along with nitrogen (N) and potassium (K). It plays a vital role in crop growth and development. It helps in strong root growth, better crop establishment, more flowering and fruiting, better grain formation and yield as well as strong and healthy plants. Many soils contain phosphorus, but most of it remains locked in the soil and cannot be used by plants. As a result, farmers often apply more phosphatic fertilizers, increasing production costs. India consumes a substantial quantity of phosphatic fertilizers every year. However, 70-80% of applied phosphorus gets fixed in soil and remains unavailable to plants. As a result, crops utilize only a small fraction of the phosphorus applied phosphorus through chemical fertilizers. The use efficiency of P-fertilizers are very less (about 15%) which increases fertilizer requirement and subsequently production costs. Further, the country's high reliance on imported phosphatic fertilizers negatively impacts its foreign exchange reserves.

1	2	3	4	5
<b>DAP</b> (Diammonium Phosphate)	<b>SSP</b> (Single Super Phosphate)	<b>TSP</b> (Triple Super Phosphate)	<b>NPK COMPLEX FERTILIZERS</b>	<b>ROCK PHOSPHATE</b>
				
<b>N</b> 18% Nitrogen (N) <b>P<sub>2</sub>O<sub>5</sub></b> 46% Phosphate (P <sub>2</sub> O <sub>5</sub> )	<b>P<sub>2</sub>O<sub>5</sub></b> 16% P <sub>2</sub> O <sub>5</sub> <b>S</b> 11% Sulphur (S) <b>Ca</b> Calcium	<b>P<sub>2</sub>O<sub>5</sub></b> 46% P <sub>2</sub> O <sub>5</sub>	Examples: • 10:26:26 • 12:32:16 • 20:20:0:13	<b>P<sub>2</sub>O<sub>5</sub></b> 18–35% P <sub>2</sub> O <sub>5</sub>
★ Most widely used phosphatic fertilizer.	★ Supplies phosphorus + sulphur and calcium.	★ High phosphorus content fertilizer.	★ Supply multiple nutrients in balanced proportion.	★ Best suited for acidic soils and compost enrichment.

Integrated phosphorus management like application of reduced dose of P fertilizer with other P sources like rockphosphate (especially in acid soils), organic manure and P biofertilizer is a sustainable option to achieve optimum yield and reduce over reliance on synthetic sources. In acid soils, amelioration with furrow liming (250-400 kg/ha) neutralizes soil and reduces P requirement. Buckwheat acts as an excellent dynamic accumulator that unlocks and recycles phosphorus for future crops, thus its inclusion in cropping system is a sustainable P management options in dry areas. Green manuring and biochar application also reduces external phosphorus requirement for the crops.

## Phosphatic Biofertilizers: As an Alternate Source of Phosphorus

Phosphatic biofertilizers contain beneficial microorganisms such as Phosphate Solubilizing Bacteria (PSB), Phosphate Solubilizing Fungi (PSF), and Mycorrhiza, which help release fixed phosphorus already present in the soil. It converts the unavailable phosphorus present in the soil into forms that plants can easily absorb. These helpful microbes act as "soil workers" and make soil nutrients available naturally. Thus, P-Biofertilizers provide benefits like

- Improving phosphorus-use efficiency
- Reducing fertilizer requirement
- Lowering cultivation costs
- Improving soil health and crop productivity

There are many differences in chemical and organic forms of P-Biofertilizers. A brief comparison of Phosphatic chemical fertilizers and Phosphatic biofertilizers is given in Table 1.

Features	Chemical Phosphatic Fertilizers	Phosphatic Biofertilizers
<b>Source of Phosphorus</b>	Directly supply phosphorus to crops	Do not supply phosphorus directly; make existing soil phosphorus available
<b>Mode of Action</b>	Provide readily available phosphorus	Solubilize and mobilize fixed phosphorus present in soil
<b>Examples</b>	DAP, SSP, TSP, NPK fertilizers	PSB (Phosphate Solubilizing Bacteria), PSF, VAM/Mycorrhiza
<b>Nutrient Content</b>	High phosphorus content (16–46% P <sub>2</sub> O <sub>5</sub> )	Living microorganisms; nutrient content not expressed as P <sub>2</sub> O <sub>5</sub>
<b>Availability to Crops</b>	Immediate nutrient supply	Gradual and continuous release of phosphorus from native soil.
<b>Efficiency</b>	Much of applied phosphorus gets fixed in soil	Improves phosphorus-use efficiency by unlocking fixed phosphorus
<b>Cost</b>	Relatively expensive and price-dependent	Low-cost input
<b>Impact on Soil Health</b>	Excessive use may affect soil biological activity	Enhances soil microbial activity and soil health
<b>Environmental Impact</b>	Excess use can cause nutrient losses and water pollution	Eco-friendly and sustainable
<b>Effect on Root Growth</b>	Indirect effect through phosphorus supply	Improves root growth and nutrient absorption, especially VAM

## Types and Benefits of Phosphatic Biofertilizers

There are mainly three types of P-Biofertilizers available. These are

1. *Phosphate Solubilizing Bacteria (PSB): Examples are Bacillus, Pseudomonas, Rhizobium spp.*

- Most commonly used phosphatic biofertilizer.
- Converts insoluble phosphorus in soil into plant-available forms.
- Produces organic acids that dissolve fixed phosphorus.
- Suitable for cereals, pulses, oilseeds, vegetables, and fruit crops.

2. *Phosphate Solubilizing Fungi (PSF): Examples Aspergillus awamori, Penicillium spp.*

- Solubilize fixed phosphorus more efficiently in some soils.
- Improve phosphorus availability through secretion of organic acids.
- Particularly useful in phosphorus-deficient soils.

3. *Vesicular Arbuscular Mycorrhiza (VAM): Example Glomus spp*

- Forms a beneficial association with plant roots.
- Extends root absorption area through fungal hyphae.
- Enhances uptake of phosphorus, water, and micronutrients.
- Particularly beneficial for horticultural, plantation, vegetable, and forest crops.

### Process of application of P-Biofertilizers

- Select healthy seeds
- Prepare jaggery solution (200 g in 1 L water)
- Mix 200-250 g PSB/PSM to this solution
- Prepare slurry and coat seeds uniformly
- Shade dry for 20-30 min.
- Sow the treated seeds

### Conclusion

Phosphatic biofertilizers provide an efficient and eco-friendly approach to improving phosphorus availability in soils. Their adoption helps reduce dependence on chemical phosphatic fertilizers, enhances nutrient-use efficiency, improves soil health, and supports sustainable crop production. Integration of phosphatic biofertilizers into nutrient management practices can significantly contribute to soil conservation, reduced input costs, and long-term agricultural sustainability.

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