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Effect of Biofertilizer Consortia (Azato + PSB+VAM) on Organic Vegetables Yield and Soil Health of Vidarbha Region, Maharashtra, India

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Vidarbha is known for cotton, soybean, and the Nagpur orange. Around Nagpur, Amravati, Akola, and Wardha, vegetable growing is also expanding, with brinjal, tomato, okra, chilli, cabbage, and cowpea feeding nearby city markets. Rising fertilizer prices, erratic rainfall, and demand for chemical-free produce are pushing many farmers toward organic methods. Organic farming has a catch. Crops still need nitrogen and phosphorus, and the region's soils are often low in both. One practical answer is a biofertilizer consortium: a mixed culture of beneficial microbes applied together to the seed, seedling, or soil.

The Soil Challenge in Vidarbha

Much of Vidarbha has medium to deep black soils (Vertisols), formed from basalt. They hold water well and are rich in clay, but they come with limits:

- **Low organic carbon**, because of high summer temperatures and fast decomposition
- **Low available nitrogen**, since organic matter is scarce
- **Phosphorus locked up**, because in alkaline, calcareous soils it binds with calcium and becomes unavailable to roots
- **Poor structure** after years of heavy tillage and chemical inputs

Organic growers cannot simply add urea or DAP. They need microbes that supply nutrients from natural sources.

Meet the Three Partners

1. Azotobacter (the nitrogen supplier). A free-living soil bacterium that fixes atmospheric nitrogen near the root zone. It also produces plant growth hormones such as auxins, gibberellins, and cytokinins, which promote root growth and seedling vigour.

2. PSB, or Phosphate Solubilizing Bacteria (the phosphorus unlocker). Species such as *Bacillus* and *Pseudomonas* release organic acids and enzymes that convert insoluble phosphate in the soil into forms plants can absorb. This matters in Vidarbha's calcareous black soils.

3. VAM, or Vesicular Arbuscular Mycorrhiza (the root extender). These fungi colonise roots and send fine threads (hyphae) far into the soil. This extends the root system, improving uptake of phosphorus, zinc, and water, which helps in drought-prone seasons. Mycorrhizal hyphae also release a sticky protein, glomalin, that binds soil particles into stable aggregates.

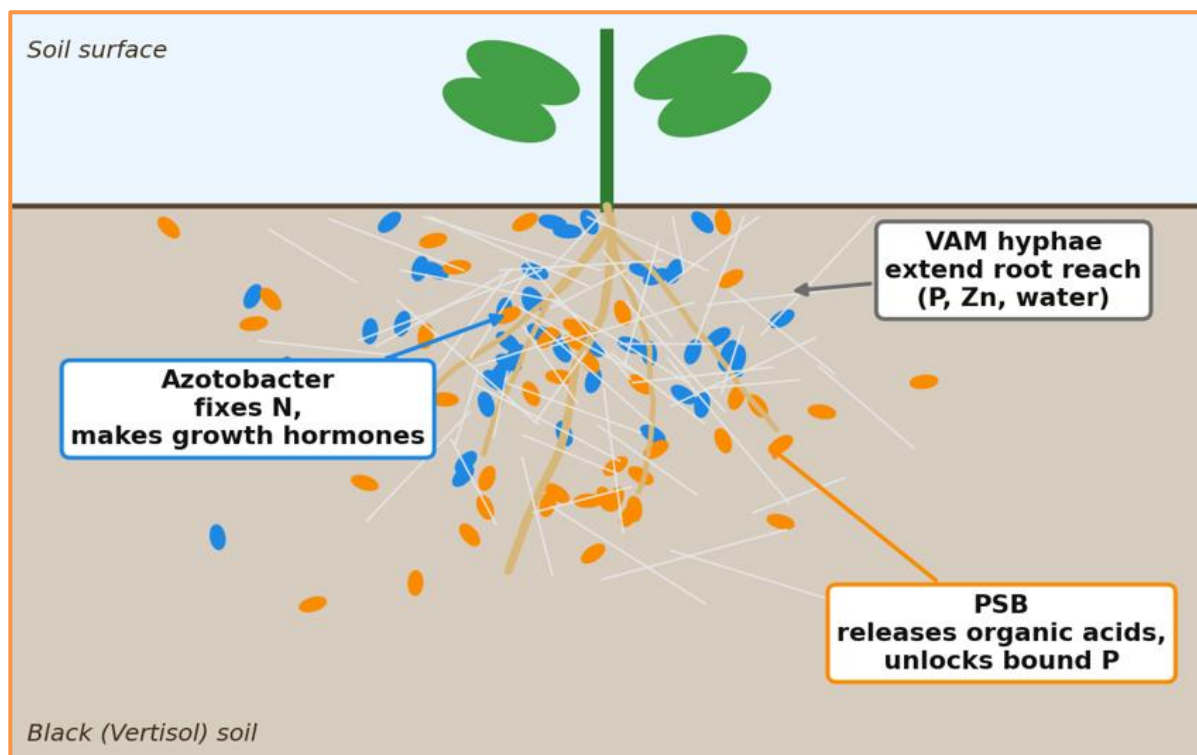


Figure 1. Azotobacter fixes N, PSB releases P, and VAM hyphae extend the root's reach

Why a Consortium Beats a Single Culture

Used alone, each organism helps one aspect of nutrition. Used together, they complement each other:

- Azotobacter growth hormones stimulate more root branching, which gives VAM fungi more places to colonise.
- Better phosphorus supply from PSB and VAM supports the energy-hungry process of nitrogen fixation.
- A richer root zone supports a more active microbial community overall.

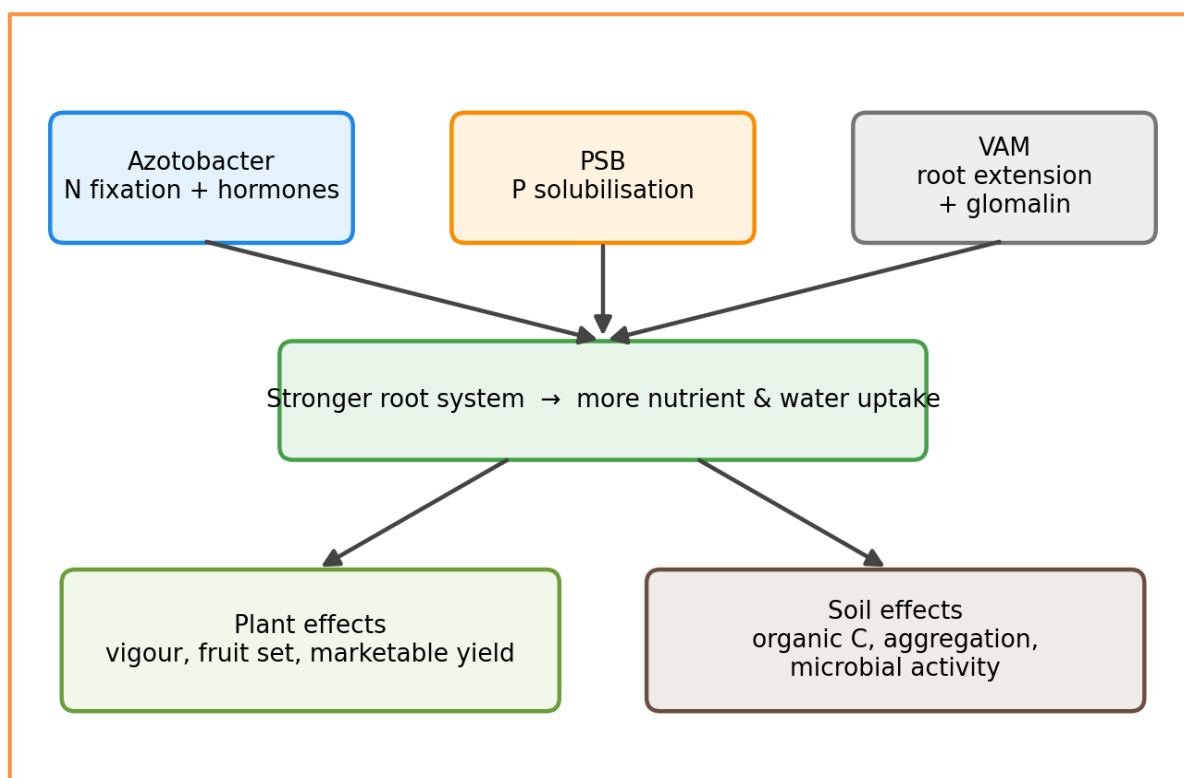


Figure 2. Pathway from the three microbes to crop and soil benefits

Table 1. Roles and benefits of the biofertilizer consortium components

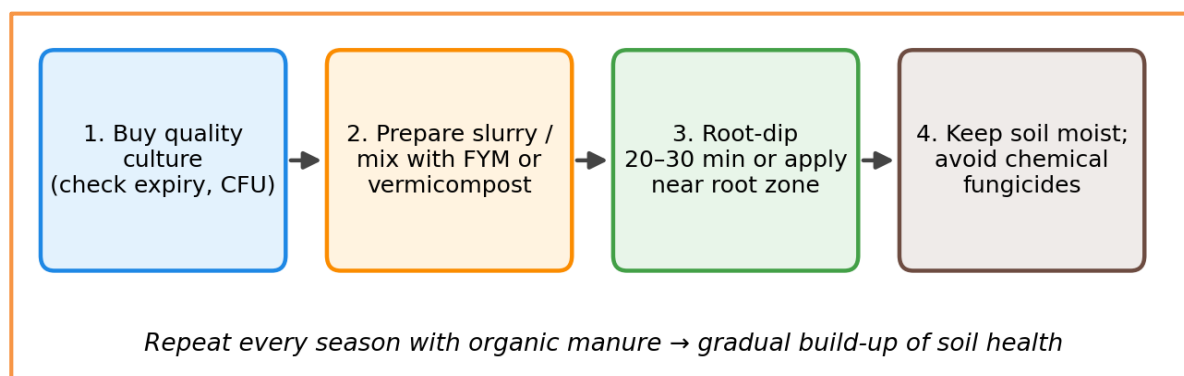
Component	Type	Main function	Benefit to vegetables	Benefit to soil health
Azotobacter	Free-living N-fixing bacterium	Fixes atmospheric nitrogen; produces growth hormones	Better seedling vigour, greener foliage, more shoots	Adds biologically fixed N; improves microbial activity
PSB	Phosphate-solubilizing bacteria	Converts bound phosphorus to available forms	Stronger root and flower development, better fruit set	Reduces dependence on external P sources
VAM	Symbiotic fungus	Extends root absorption zone; improves water and nutrient uptake	Better drought tolerance, more efficient P and Zn uptake	Improves soil aggregation through glomalin
Consortium (all three)	Combined culture	Complementary N, P and root-extension effects	Generally higher and more stable yield than single inoculants	Gradual build-up of organic carbon, structure and biological activity

What Farmers and Researchers Observe

Trials with microbial consortia on vegetables across India generally report improved plant height, root length, number of fruits per plant, and marketable yield compared with uninoculated controls, and often compared with single-organism treatments. Soil benefits typically include higher microbial counts, enzyme activity (such as dehydrogenase and phosphatase), and available nutrients, with improved organic carbon over repeated seasons. Results depend on the crop, soil, organic manure used, and inoculant quality, so gains vary widely between sites. For region-specific figures, consult local trial data from Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola, or the local KVKs.

How to Apply It in the Field

- Seedling root dip:** Dip transplant roots for 20–30 minutes in a slurry of Azotobacter and PSB before planting.
- Soil application:** Mix the cultures with well-decomposed FYM or vermicompost and apply near the root zone. VAM is usually applied at sowing or transplanting, placed close to the roots.
- Do not mix with chemicals:** Avoid chemical fungicides and pesticides near the application. They can kill the microbes.
- Keep soil moist:** Apply under moist, not waterlogged, conditions.
- Buy quality:** Choose products with a manufacturing date, expiry date, and viable cell count (CFU) on the label, from reliable sources such as agricultural universities or accredited suppliers.
- Store properly:** Keep packets cool and shaded, and use them before expiry.

**Figure 3. Simple field workflow for applying the consortium in organic vegetables**

Soil Health: The Long-Term Payoff

Biofertilizers are not a quick fix like urea. Their value builds season after season. Better root growth adds organic matter. Active microbes cycle nutrients, and mycorrhizal glomalin helps bind the heavy clay into crumbly aggregates that hold both air and water. Over time, farmers can reduce external inputs while sustaining yield and quality, which also lowers cost of cultivation.

Conclusion

For Vidarbha's vegetable growers going organic, an Azotobacter + PSB + VAM consortium offers a low-cost, eco-friendly way to improve nutrient supply, yield, and soil health together. Combined with compost, crop rotation, and good water management, it helps keep black soils productive for the next generation.

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