Beneficial bacteria for sustainable crop production in smallholder agro-ecosystems

Insights on the impact of bioinoculants application on soil, also crop health and nutrition

MSSRFD41 tested under multi-location trials

~100 PGPR isolates

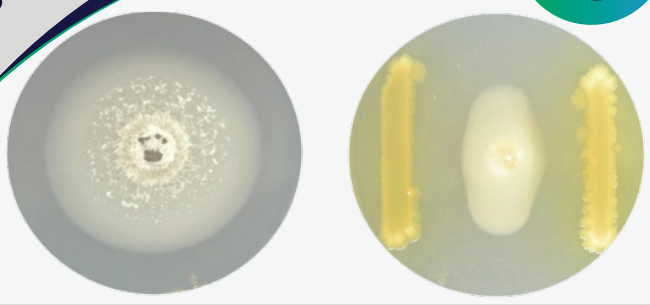
Context

Soil degradation restrains soil nutrition status and is considered as a significant cause to threaten global nutrition security. Soil management practices that enhance biological contributions to soil fertility and support sustainable farming systems is gaining more attention. One of the approaches for regenerative soil system is the use of cultured plant growth promoting microorganisms to achieve crop productivity. This has evolved as an alternative or supplement to chemical inputs. Biofertilizers and biopesticides are thus a promising option for sustainable soil health management as it enhances crop productivity and improves crop health under adverse environmental conditions, and to control pests and diseases without the use of agrochemicals.

Intervention

At MSSRF, a large number of Plant Growth Promoting Rhizobacteria (PGPR) strains such as *Azospillium, Acetobacter, Pseudomonas, Bacillus, Brevibacillus,* etc., have been isolated and characterised for their plant growth promoting traits, novel genus, and novel species reported from the agriculture ecosystems. These isolates possess the ability to fix atmospheric nitrogen, solubilise phosphate and potassium, micronutrients such as iron and zinc, produce phytohormone such as Indole Acetic Acid, and exhibit biocontrol activities against pests and pathogens. The potential of the PGPR in crop yield enhancement was shown in experimental as well as demonstration and on-farm trials. A well characterised *Pseudomonas sp.* MSSRFD41, isolated from finger millet rhizosphere holds several plant growth and disease protection traits.

The PGPR potential of this strain has been well assessed under multi-location field trials as individual application and when applied as a consortium under monocropping and intercropping systems of millet with pulses. As a consortial application with Arbuscular Mycorrhizal Fungi (AMF), it showed significant performance in terms of grain yield compared to control. Intensive training on the use of the bioinoculants for sustainable soil and crop management has been organised among small and marginal tribal farming communities, thus promoting integrated nutrient and disease management practices. A pilot production unit of biofertilizer by fermentation has been set up with a capacity of 50 litres. A polyhouse pilot-scale production model unit of AMF with the production capacity of 500 kgs/batch was setup. This facility serves as a training centre to promote young enterprises and has trained women Self-Help Groups (SHGs) on the mass multiplication of the bioinoculants. Three bioinoculants production units managed by the SHGs are successfully promoting the use of quality bio-product among farming communities.



15
Publications

3
Ph.D Thesis

Outputs

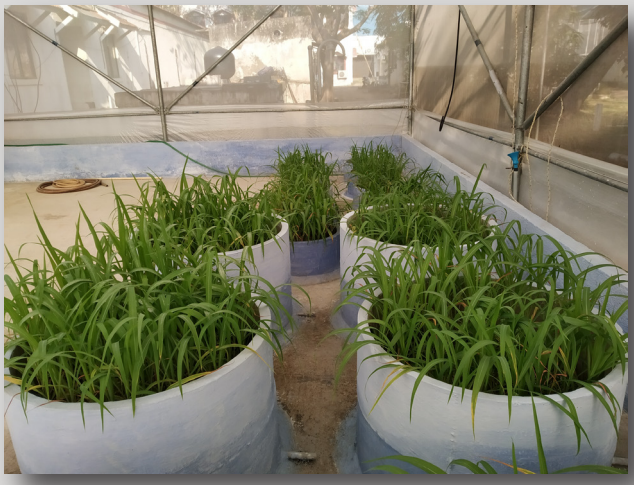
* Isolated and characterised ~100 PGPR isolates from agriculture ecosystems with multiple plant growth promoting traits *in vitro* and *in vivo* conditions.
* *Pseudomonas sp.* MSSRFD41 tested under multi-location trials for three consecutive seasons in finger millet mono-cropping, also intercropping with pulses resulted in yield enhancement by 30 percent, and in semi-arid agroecosystems under 50 percent recommended dose of fertilizer application.
* Awareness on the use of bioinputs was created among ~ 2000 small and marginal tribal farming communities through demonstration trials and on-farm demonstrations in Kolli hills in Tamil Nadu, Koraput, Malkangiri and Rayagada in Odisha, and Wayanad in Kerala.
* Ecoenterprises managed by women SHGs are successfully running with production units, supplying quality products to local farmers to promote 11 types of products.
* Use of bioinoculants resulted in reduced application of inorganic inputs without yield compromise in finger millet and pulses, and also reduced cost of cultivation.
* Fifteen publications in peer reviewed journals and three Ph.D thesis were awarded.

Outcomes

Soil nutrition management is mostly based on chemical inputs, the potentials of soil microbes to enhance the regenerative capacity of soil systems for agriculture has been demonstrated. Farmers are coming forward to adapt these technologies, thus the future agricultural production systems need to be re-designed to cope with climate change and increasing intensification of land use with the available renewable resources. Bioinoculants application improves soil nutrient status, plant nutrients available, crop yield and quality, while reducing input costs.

Further Reading

* Jegan, S., Raju, K., Duraisamy, P., and Ramalingam, P.V., 2018. Potential of finger millet indigenous rhizobacterium Pseudomonas sp. MSSRFD41 in blast disease management-growth promotion and compatibility with the resident rhizomicrobiome. Front Microbiol. 9, 1029.
* Jegan, S., Prabavathy, V.R. and Sudha Nair 2010. Biocontrol and functional properties of pseudomonads isolated from different ecological niches and diversity of phlD a key gene in the 2,4-DAPG biosynthesis. Phytopathology 100 (6): S116-S117.
* Jegan, S. and Prabavathy, V.R. 2014. Novel Phl-producing genotypes of finger millet rhizosphere associated pseudomonads and assessment of their functional and genetic diversity. FEMS Microbial Ecology 89: 32–46.
* Natarajan M#, Jegan, S., Thimmegowda, M.N., Prabavathy, V.R., Thomas, B., Paul, M., et al., 2020. Intercropping transplanted pigeon pea with finger millet: Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria boost yield while reducing fertilizer input. Frontiers in Sustainable Food Systems, 4, 88.



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