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The Soil Glow-Up: Turning Agricultural "Trash" into Organic Gold

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The Problem: Chemical Fatigue

Today's agriculture is facing increasing environmental sustainability challenges. Excessive reliance on chemical fertilisers has caused environmental degradation for decades, including nutrient leaching, soil acidification, and a colossal decline in microbial biodiversity (Kumar et al., 2022). To address these environmental problems, researchers have developed biofertilizers as sustainable substitutes to chemical fertilisers (Zhao et al., 2024). Although chemical fertilisers support crop productivity, excessive dependence may degrade soil health. Meanwhile, the mushroom production industry produces enormous amounts of spent mushroom waste (SMW) and agricultural residues that are underutilised despite their potential as sustainable agricultural substrates (Maurya et al., 2020).

BioRhizo Brick and SMartGro BioBoost Innovations

To address this issue, we designed and implemented two award-winning innovations to support a circular economy: BioRhizo Brick and SmartGro BioBoost. Through aerobic fermentation, we converted SMW and agricultural residues such as banana leaves and coconut husks into high-value bio-inputs. Both products are enriched with native *Rhizobium* strains, which act as Plant Growth-Promoting Rhizobacteria (PGPR) crucial for sustainable agricultural production (de Andrade et al., 2023; Fasusi & Babalola, 2021).

The beneficial microbes were derived from the rhizosphere of healthy plants at a local farm in Kampung Buyau, Seri Menanti, Negeri Sembilan. We designed two delivery systems tailored to different farming lifestyles: a) BioRhizo Brick (Solid-State) a compressed, odorless and lightweight slow-release block formulation that is designed for home gardens and smallholder farmers who want the benefit of long-term soil health with minimal effort, and b) SMartGro BioBoost (Liquid-State) is a formulation for speed that can be diluted and used as a foliar spray or soil drench, providing farmers with flexibility in providing a stimulus for plant growth during crucial periods of development. The development of both solid and liquid delivery formats mirrors global best practices in biofertilizer design, which emphasise the need to adapt formulations to diverse agro-ecological contexts and end-user capabilities.

Award-Winning Real-World Impact

These innovations are not merely laboratory experiments; they are real-world solutions that have been tested and validated for their effectiveness in practice. BioRhizo Brick and SMartGro BioBoost competed for and won awards for the real-world impact on sustainable agriculture. Given that the majority of smallholder farmers in Malaysia and across Southeast Asia are engaged in agriculture, it is particularly crucial to provide soil amendments that are cost-effective, efficient, and easy to utilise.

Chemical fertilisers may be suitable for crop productivity but are more expensive and have long-term environmental implications, including impacts on groundwater and greenhouse gas emissions (Kumar et al., 2022). In contrast, these new biofertilizers are locally available at a lower cost, enabling rural areas to enrich their lands without overharvesting natural resources. Furthermore, the native

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Rhizobium strains are isolated directly from local farm soil and are therefore ecologically well-suited, adapted to the regional climate and climate-specific crop types; this greatly improves the field performance of the bacteria compared with standard commercial strains (de Andrade et al., 2023).

In addition, the circular economy rationale of both products, by transforming farmland and waste from mushroom cultivation into value-added inputs, addresses two issues in parallel: the burden of SMW on landfills and the restoration of soil health (Maurya et al., 2020). This dual role is particularly relevant for rural agro-industrial communities, where mushroom cultivation and small-scale farming activities coexist.

Figure 1
Gold & Silver Awards for Introducing Biofertilizer Innovations

Note. Gold Award for BioRhizo Brick and Silver Award for SMartGro BioBoost at the 2nd SDG Innovation on 20 September 2025. Images from the authors' personal collection.

Figure 2
Final Innovations: BioRhizo Brick and SMartGro BioBoost

Note. The compressed solid-state BioRhizo Brick and the concentrated liquid SMartGro BioBoost are ready for field application. Images from the authors' personal collection.

To validate their effectiveness, we conducted extensive laboratory bioassays using mung beans as the test crop. The results showed significant improvements over untreated controls, which confirmed the dual power of nutrient enrichment and active microbial metabolites (Fasusi & Babalola, 2021).

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a) Outstanding Seedling Fierceness and Growth: Both formulations markedly improved early development of the plant. For the liquid SMartGro BioBoost, we achieved an impressive Germination Index (GI) of 126.4%, indicating no toxicity and very high stimulation of seedling growth. Similarly, BioRhizo Brick was able to germinate seeds at above 90% GR, with similar rates observed. Treated seedlings have significantly longer root systems and far more resistant, greener shoots visually than the control groups. In addition, the bricks-treated soil contained significantly higher concentrations of nitrogen (N), phosphorus (P), and potassium (K),

b) Resilient microbial life-span: In order to make any commercial biofertilizer, the actual task is to maintain the health of the beneficial bacteria that should be on the biofertilizer at all times during packaging and storage. Our processing methods successfully preserved microbial activity. Despite filtration of fermented waste to obtain a concentrated liquid or sun-drying and compressing it into solid bricks, the organic matter and the Rhizobium populations remained very abundant and viable. Plate count analysis showed a total viable cell count of 1,000,000+ CFU/g (CFU/mL) of both products post-processing (Islam et al., 2023). This ensures that the "living" biological engine of the fertiliser remains engaged and ready to colonise plant roots the moment it is introduced into the soil.

Conclusion: One Crop, One Time, Save the Planet.

By transforming waste into valuable biofertilisers, these innovations are regarded as eco-friendly solutions for nutrient recycling and environmental sustainability. They directly contribute to the United Nations Sustainable Development Goals, including Zero Hunger (SDG 2), Responsible Consumption and Production (SDG 12), and Climate Action (SDG 13). In practical terms, BioRhizo Brick and SMartGro BioBoost have the potential to be scaled beyond the laboratory and into the hands of farmers across Malaysia and the region. With further field trials, partnerships with agricultural agencies, and policy support, these biofertilizers can serve as model innovations demonstrating how university research translates into tangible community benefit. As biofertiliser adoption has grown globally over the past four decades (Zhao et al., 2024), our locally derived, waste-valorising products stand at the frontier of this movement. Selecting biofertilisers isn’t merely a trend; it’s also a much-needed step toward a future of sustainable food production, one that treats the earth as seriously as the harvest it yields.

References

de Andrade, L. A., Santos, C. H. B., Frezarin, E. T., Sales, L. R., & Rigobelo, E. C. (2023). Plant growth-promoting *Rhizobacteria* for sustainable agricultural production. *Microorganisms*, *11*(4), Article 1088. https://doi.org/10.3390/microorganisms11041088

Fasusi, O. A., & Babalola, O. O. (2021). The multifaceted plant-beneficial rhizobacteria toward agricultural sustainability. *Plant Protection Science*, *57*(2), 95–111. https://doi.org/10.17221/130/2020-PPS

Islam, Z. F., Cherepanov, P. V., & Hu, H. W. (2023). Engineering biodegradable coatings for sustainable fertilisers. *Microbiology Australia*, *44*(1). https://doi.org/10.1071/MA23003

Kumar, S., Diksha, Sindhu, S. S., & Kumar, R. (2022). Biofertilizers: An ecofriendly technology for nutrient recycling and environmental sustainability. *Current Research in Microbial Sciences*, *3*, Article 100094. https://doi.org/10.1016/j.crmicr.2021.100094

Maurya, B., Verma, D., Didwana, V., & Maurya, B. (2020). Spent mushroom substrate: A potential sustainable substrate for agriculture. *International Journal of Grid and Distributed Computing*, *13*(2).

Zhao, G., et al. (2024). Development of biofertilizers for sustainable agriculture over four decades (1980–2022). *Geography and Sustainability*, *5*(1), 19–28. https://doi.org/10.1016/j.geosus.2023.09.006