

Development of Sustainable Liquid Biofertilizers from Agriculture Wastes Utilising Effective Microbial Formulations and the Enzymatic Analysis

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Structured Abstract

Background: Agriculture generates organic solid waste, and over reliance on chemical fertilisers has raised concerns regarding soil health and environmental sustainability. The transformation of underutilised leftovers, including coconut husk, rice straw, OFEPB, and BSF frass, into value-added goods has garnered attention. Liquid biofertilizers including advantageous microbial consortia offer an opportunity to enhance these resources and elevate crop quality and nutrition. This project is on standardising the manufacture of lignocellulosic biomass fuel (LBF) from accessible agro-waste and assessing the impact of various microbial inoculants, including commercial solutions like TerraGrow, on the degradation of raw materials and the growth performance of seedlings. The ultimate objective is to provide an environmentally sustainable long-term solution to the issues associated with synthetic fertilisers and agro-waste.

Methods: A comprehensive experimental study was conducted, entailing a sequential assessment of the biodegradation of several raw materials, with specialised microbial consortium (*Bacillus*, *Brevibacillus*, *Pediococcus*, *Candida*, *Rhizobium*, and *Trichoderma*, supplemented in TerraGrow). The activity of the enzymes (cellulase, protease, ligninase, pectinase, and chitinase) were assessed. The induced liquid biofertilizer mixes were formulated and optimised with the Box-Behnken statistical model to ascertain the optimal substrate combination. The product's quality was assessed using pH stability after 28 days of storage. Efficacy assays were performed on red amaranth seedlings with a hydroponic growing method, and growth characteristics were compared to those of a standard commercial AB liquid fertiliser and negative controls.

Results: The amplification of microbial addition, particularly with TerraGrow, significantly enhanced the bio-degradation rate of challenging substrates such as coconut husk and EFB, accompanied by elevated enzymatic activity. The compositions exhibited constant pH and maintained viable microbe numbers. The optimised biofertilizer considerably improved plant growth metrics (shoot, root, and total length) compared to the commercial fertiliser, with the superior growth-performance formulation statistically validated using MiniTab.

Conclusion: The study indicates that liquid biofertilizer derived from agricultural waste containing microbial consortia is technically possible and efficient for promoting plant growth. The method provides an environmentally friendly way to manage nutrient sources and to reduced dependence on synthetic fertilizer, contributing toward environmental sustainability as well as increased agriculture productivity.

Keywords: Agricultural Waste, Liquid Biofertilizer, Biodegradation, Enzymatic Activity, Sustainable Agriculture

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