From Waste to Worth: Repurposing Resistant Starches in Wasted Rice Into Controlled-Release Fertilizer

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Rice is the most commonly wasted food, with an estimated 38 kg wasted per person annually. This contributes to 12% of methane emissions and 1.5% of global greenhouse gas emissions, straining land and water resources. In Phase I, rice's resistant starch properties were used to create a single-use plastic alternative. This project (Phase II) establishes a sustainable circular economy model when addressing rice food waste by evaluating the real-world applicability of these degradable materials. Samples composed of rice starch, glycerol, and cornstarch were subjected to controlled gelatinization-retrogradation cycles and analyzed for water absorption rates, mechanical stability, and decomposition behavior. This material's effectiveness as an organic fertilizer was assessed based on germination rates, soil chemistry, and plant health of sample-coated string bean seeds. Their effect on soil chemistry, germination time, and plant growth was closely monitored. Glycerol-enhanced films showed the greatest durability and the lowest water absorption (12.66%), though still too high for most industrial applications. As seed coatings, these films accelerated germination by two weeks and improved plant growth rates by 30.77% compared to controls, while maintaining soil health. One-way ANOVA results were statistically significant ($p<0.001$) for both plant growth and soil nitrogen levels. While further improvements in water resistance are needed, the study demonstrates a viable, sustainable solution to reduce rice waste and replace chemical fertilizers. This process, especially in remote regions, offers a scalable method for transforming food waste into valuable resources, reducing environmental harm from plastic pollution and synthetic agricultural inputs.

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