

ABSTRACT

Indonesia's agricultural sector is currently facing major challenges in increasing productivity while maintaining environmental sustainability, particularly due to high dependence on chemical fertilizers and declining soil quality. In line with the 2060 net-zero carbon emissions target, environmentally friendly approaches such as the use of electrolyte water (alkaline and acidic) as an alternative to chemical fertilizers are needed. This study evaluates the use of a 20 Wp solar-powered Portable Water Ionizer (PWI) with five types of electrolyte solutions (NaCl, KCl, NH₄Cl, KIO₃, and raw water) to assess energy consumption, electrolysis efficiency, and their impact on soil and plant growth.

Results showed that the system with electrolyte solutions had up to 33% higher Power Utilization Index (PUI) compared to one without solutions, and was consistent with hydrogen gas production during the electrolysis process. Alkaline electrolyte water was found to effectively increase soil pH from acidic to neutral (6.3–7.0) without significantly altering soil moisture. Treatment with KCl and KIO₃ under alkaline conditions (P3) showed optimal growth in green spinach, red spinach, and water spinach, while NaCl and NH₄Cl inhibited growth due to ion toxicity. These findings support the potential application of solar-powered electrolysis systems with specific electrolyte solutions as a sustainable approach in modern agriculture.

Keywords: Electrolysis, Agriculture, Alkaline Water, Solar Cell Module, Optimal Soil