The Great Azolla Event II: Harnessing Electrical Energy From Oxidative Phosphorylation During Respiration in Aquatic Flora, Azolla filiculoides

Mazambani, Tatenda (School: Princeton Institute)

Evidenced by mass load-shedding and power-cuts on a local & global scale, energy shortages and their effects on sustainable development are becoming more prominent especially in the developing world. The purpose of this research is to investigate the potential that a local pond weed species, native to Sub-Saharan Africa, called Azolla Filiculoides, has to generate electrical energy during cellular respiration. At a stage called oxidative phosphorylation in respiration, electrons are released by cytochrome c6 (electron donor) to reduce NAD+ and FADH before entering the electron transport chain (ETC). Upon reaching the inner membrane of mitochondria, electrons set up an electrochemical gradient. The major role of this process is to make ATP molecules but the numerous electron pathways set up allow an external circuit to harness the excess electrons excreted. Using a novel biological photovoltaic device designed by mimicking an electrochemical cell, a potential difference was detected. For 1m^2, 14.4V are generated over 30 seconds. Voltages were also investigated with variable masses and contact areas showing positive correlation with each variable. The findings show that electrons can be intercepted to harness electrical energy directly from respiration in plants. Azolla F. is a rapidly-renewable and affordable alternative to common existing energy sources. It has various benefits for commercial and subsistence farmers, significantly as an energy source. 15.5m^2 Azolla would be needed to generate 230V , which is the mains supply voltage for most households. There is room for further developments to maximize on yield of energy harnessed from the plant.

Awards Won: