The Efficacy of Rhodophyta as a Seaweed Liquid Fertilizer Through Okra and Arabidopsis Growth, Pigment Concentration and Macronutrient/Micronutrient Distribution Using Tender Energy Spectroscopy

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Invasive Rhodophyta (red macroalgae) species Dasysiphonia japonica & Gracilaria are threatening environmental and human health by outcompeting native seaweeds and releasing toxins from harmful algal blooms (HABs). This project takes advantage of Rhodophyta's bioavailable nutrient content to repurpose these otherwise devastating species into a sustainable alternative to chemical fertilizers. This study tests the efficacy of D. japonica and Gracilaria as Seaweed Liquid Fertilizer (SLF) as a foliar spray and soil drench respectively on okra (Abelmoschus esculentus) growth and chlorophyll a, b, and carotenoid pigment concentration. SLF was diluted and tested at varying concentrations based on application, and compared to a chemical fertilizer. Additionally, arabidopsis (Arabidopsis thaliana) was grown in plant-based agar plates combined with concentrations of Gracilaria SLF and chemical fertilizer. Arabidopsis plants were analyzed with Tender Energy Spectroscopy on the National Synchrotron Light Source 2. Elemental distribution maps of P, K, Ca, S, Cl, etc. were constructed using energy spectrums of 2400 eV and 4200 eV, revealing SLFs' and chemical fertilizers efficiency in providing nutrients necessary for plant development, densely located at the plant's axil and leaves sustaining future growth. Overall, in each tested factor, SLF groups performed similarly to each other, more effectively than the control group, and as effective as the chemical fertilizer. T-tests and ANOVA tests were used to confirm statistical significance. These results support that SLF can be a viable substitute for chemical fertilizers and offer a multi-purpose solution that can mitigate eutrophication and future HABs while removing an invasive species to protect our coastal environment.