

Beyond Nutrients: The Role of Macroalgae Derived Growth Regulators in Sustainable Agriculture

Valentino Russo and Damiano Spagnuolo, Promethea Biochem Solution, TA (Italy)

Promethea Biochem Solution, based in TA, Italy, specializes in developing engineered liquids such as Deep Eutectic Solvents (DES) and ionic liquids for extracting metabolites from complex matrices, solubilizing poorly soluble APIs, and synthesizing nanoparticles. Our expertise extends to the characterization of these materials using advanced techniques like Scanning Electron Microscopy (SEM), Fourier-Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR), Quartz Crystal Microbalance (QCM), UV/VIS Spectroscopy, quantum mechanical simulations, Molecular Dynamics (MD), and ligand-receptor docking. A key challenge in extracting metabolites from macroalgae matrices is the presence of complex polysaccharides, which can trap or degrade secondary metabolites when using traditional methods. By utilizing engineered solvents, these barriers can be overcome, facilitating the release and preservation of valuable bioactive compounds. The growing interest in sustainable agriculture has brought attention to macroalgae-derived fertilizers, which offer benefits beyond simple nutrient supplementation. Unlike conventional fertilizers, macroalgae extracts are rich in plant growth regulators (PGRs), including genuine phytohormones, that enhance plant health and growth through mechanisms beyond nutrient provision alone. On the other hand the extraction process can seriously compromise the persistence of active molecules and their conservation is equally complex. DES can be a solution.

Macroalgae-based products can be formulated as mixtures of extracts containing the optimal pool of PGRs tailored to specific plant growth stages, and they can also offer additional benefits, such as protection against drought or heat waves. The effectiveness of these protective functions, like the growth-regulating properties, depends heavily on the specific species of macroalgae used, given the vast diversity of algae and the wide range of bioactive compounds they produce. Despite the promising potential, the study of macroalgae-derived fertilizers is still in its early stages. Further research is needed to fully elucidate the mechanisms by which macroalgae PGRs contribute to plant growth and to refine extraction and application methods to maximize their agricultural benefits.