Research paper **IL 2**

PLASMA ACTIVATED WATER FOR SUSTAINABLE AGRICULTURE: PLANT STRESS MITIGATION AND FOOD SAFETY

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ABSTRACT

Plasma Activated Water (PAW) has attracted increasing interest across scientific disciplines due to its potential to promote plant growth, mitigate environmental stress, and inactivate microorganisms. During plasma–liquid interactions, reactive oxygen and nitrogen species (RONS) generated by plasma are transferred into the aqueous phase, resulting in changes in physicochemical properties, including decreased pH and increased conductivity, as well as enrichment with reactive species such as hydrogen peroxide (H_2O_2), nitrite (NO_2^-), and nitrate (NO_3^-). Nitrogen species can provide nutrients that support plant growth, while H_2O_2 and acidification contribute to the antimicrobial properties of PAW [1]. Depending on the intended application, PAW can be produced from different water sources, including distilled water, tap water, and wastewater [2].

This work investigates the effects of PAW on plant growth and elemental uptake under different stress conditions, including heavy-metal contamination, salinity, or drought. Plants were cultivated under controlled conditions and exposed to selected abiotic stressors. Plant growth and stress-related responses were evaluated, with particular emphasis on elemental uptake and redistribution within plant tissues. The spatial distributions of selected elements were determined using Laser-Induced Breakdown Spectroscopy (LIBS). LIBS is an optical emission spectroscopy technique based on laser-induced plasma and enables rapid multi-element analysis with spatially resolved detection [3].

The study contributes to understanding the interactions among PAW, abiotic stress, and elemental uptake in plants and evaluates the potential of plasma-based water treatment as a tool for improving plant resilience and supporting safer and more sustainable agricultural production.

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