

Green Synthesis, Characterization and Application of *Artemisia absinthium*-mediated AgNPs in Wheat Salinity Stress Mitigation and Synthetic Dye Photocatalysis

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Abstract

Soil salinity severely restricts agricultural productivity, posing a significant threat to global food security. Aligning with the need for innovative agricultural technologies, this study investigates biologically synthesized silver nanoparticles (AgNPs) as a sustainable dual-purpose solution for enhancing crop resilience and environmental remediation. AgNPs were green-synthesized using *Artemisia absinthium* extract and characterized via UV-Vis spectroscopy, FTIR, and SEM. To evaluate crop protection, two wheat cultivars ('Abundant' and 'Avenue') were primed with water, AgNPs, NaCl (50–150 mM) and AgNP-NaCl combinations. Salinity stress mitigation was assessed through biochemical markers, including lipid peroxidation (MDA) and antioxidant activity (SOD, CAT, POD, phenolics and flavonoids). Additionally, the environmental remediation potential of the AgNPs was tested via photocatalytic degradation of methylene blue (MB) under simulated solar irradiation.

Characterization confirmed the successful synthesis of well-dispersed, spherical AgNPs (30-60 nm). Plant assays revealed that antioxidant responses varied by cultivar, CAT activity increased in the 'Abundant' cultivar under moderate salinity, while other oxidative stress markers (SOD, POD, MDA) generally stabilized or decreased, indicating mitigated stress without compromising plant dry matter or protein content. Furthermore, the AgNPs demonstrated highly efficient environmental remediation, achieving 90% initial adsorption and 97% photocatalytic degradation of MB. Ultimately, this study highlights biogenic AgNPs as a promising, sustainable nanotechnology for securing crop yields under environmental stress and decontaminating water.

Index Terms

Triticum aestivum, Biogenic AgNPs, Seed Priming, Salinity Stress, Photocatalytic Degradation