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Biochar and Zinc Oxide Nanoparticle-Based Soil and Seed Priming for Enhancing Morphological, Physiological, and Biochemical Traits of Armenian Wheat (*Triticum aestivum* L.) Genotypes Under Salinity Stress

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ABSTRACT

Salinity is one of the critical abiotic stresses negatively affecting wheat (*Triticum aestivum* L.) germination, seedling development, and yield potential. This study evaluates the efficacy of biochar-based soil and NPs based seed priming along with zinc oxide (ZnO-NPs) in enhancing salt tolerance in two Armenian (Gohar and Van) wheat genotypes under three different levels of salinity stress (100, 200, and 300 mM). Seeds were primed with 50 and 100 mg/L concentrations of each ZnO-NPs and 1.3 % biochar. Morphological parameters (shoot/root length, fresh and dry biomass), physiological traits (plant height, transpiration rate), and biochemical characteristics (Na^+, Cl^-, and K^+ ion concentrations, MDA, and antioxidant) were assessed. Salinity stress significantly impaired with these parameters' growth and development in both genotypes. The findings suggest that priming of soil with biochar and seed with ZnO-NPs (50 and 100 mg/L) can serve as an efficient and sustainable strategy to mitigate salt-induced damage during early wheat development. These results support further investigation into priming technologies for improving crop resilience in salt-affected soils.

Keywords: biochar, ZnO, salinity stress, wheat, priming

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