Evaluation of Selenium Nanoparticles in Inducing Disease Resistance against Spot Blotch Disease and Promoting Growth in Wheat under Biotic Stress

ABSTRACT

In the present study, SeNPs were synthesized using Melia azedarach leaf extracts and investigated for growth promotion in wheat under the biotic stress of spot blotch disease. The phytosynthesized SeNPs were characterized using UV-visible spectroscopy, scanning electron microscopy (SEM), energy-dispersive X-ray (EDX), and Fourier-transformed infrared spectroscopy (FTIR). The in vitro efficacy of different concentrations of phytosynthesized SeNPs (i.e., 100 µ g/mL, 150 µ g/mL, 200 µ g/mL, 250 µ g/mL, and 300 µ g/mL) was evaluated using the well diffusion method, which reported that 300 µ g/mL showed maximum fungus growth inhibition. For in vivo study, different concentrations (10, 20, 30, and 40 mg/L) of SeNPs were applied exogenously to evaluate the morphological, physiological, and biochemical parameters under control conditions and determine when infection was induced. Among all treatments, 30 mg/L of SeNPs performed well and increased the plant height by 2.34% compared to the control and 30.7% more than fungus-inoculated wheat. Similarly, fresh plant weight and dry weight increased by 17.35% and 13.43% over the control and 20.34% and 52.48% over the fungus-treated wheat, respectively. In leaf surface area and root length, our findings were 50.11% and 10.37% higher than the control and 40% and 71% higher than diseased wheat, respectively. Plant physiological parameters i.e., chlorophyll a, chlorophyll b, and total chlorophyll content, were increased 14, 133, and 16.1 times over the control and 157, 253, and 42 times over the pathogen-inoculated wheat, respectively. Our findings regarding carotenoid content, relative water content, and the membrane stability index were 29-, 49-, and 81-fold higher than the control and 187-, 63-, and 48-fold higher than the negative control, respectively. In the case of plant biochemical parameters, proline, sugar, flavonoids, and phenolic contents were recorded at 6, 287, 11, and 34 times higher than the control and 32, 107, 33, and 4 times more than fungus-inoculated wheat, respectively. This study is considered the first biocompatible approach to evaluate the potential of green-synthesized SeNPs as growth-promoting substances in wheat under the spot blotch stress and effective management strategy to inhibit fungal growth.