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Evaluating the Efficacy of *Cassia fistula* L. Based Nanoparticles of CuO, ZnO and their Nanocomposites for Mitigating Drought Stress in Lentil (*Lens culinaris*)

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Abstract

Amaltas (*Cassia fistula* L.), which belongs to *Fabacea* family is widely used in medical, cosmetic and agricultural field. Its seeds and leaves are thought to be beneficial parts of plants because of the presence of variety of active compounds in them. The primary objective of this study was to assess the effect of *Cassia fistula*-derived nanoparticles on lentil as nanobiofertilizer. For this purpose, ZnO, CuO nanoparticles and their bimetallic nanocomposites were synthesized using *Cassia fistula* leaves extract and characterized using UV-Visible Spectrophotometry, Fourier transform infrared spectroscopy (FTIR), Scanning electron microscopy (SEM), Dynamic light scattering (DLS) and X-ray Diffraction analysis (XRD) to assess the chemical and physical properties of these nanoparticles. Three types of nanoparticles were then applied on lentil plants for mitigating drought stress in present investigation. Two types of stress were applied to the plants i.e., moderate and severe stress. Synthesized nanoparticles were applied in three concentrations i.e., 100 mg/l, 250 mg/l, 500 mg/l on plants. Morphological and biochemical traits were studied to evaluate the results. It was observed that stress caused increase in root fresh and dry weight, root length, and number of lateral roots but when nanoparticles were applied, plant roots recovered from this effect depending upon the concentration of applied nanoparticles. Comparing the results of three concentrations of nanoparticles, maximum of root parameters were observed in plants with 100 mg/l concentration and minimum were observed by plants with 500 mg/l concentration. Shoot parameters including shoot length and shoot fresh & dry weight gave maximum readings in control plants and minimum were observed in plants with 500mg/l concentration of nanoparticles. In stressed condition, biochemical parameters like catalase and peroxidase activity and hydrogen peroxide content in plants increased but when nanoparticles were applied on these plants, their concentration decreased showing a positive impact on plants condition. This study is a pathway in unraveling the potential of plant-derived nanoparticles as nanobiofertilizers offering significant benefits to the agricultural sector in future.

Keywords: *Cassia fistula; Lens culinaris; Drought; Nanoparticles; Nanocomposites; nanobiofertilizers*