ABSTRACT

Metal NPs are very extensively studied for their pharmaceutical, biomedical and industrial applications but are comparatively least studied for their potential in agricultural sector. On the other hand, the tremendous increase in population has recently raised the demand for food mostly in developing countries. Therefore, there is an urgent need to develop eco-friendly technologies which can increase the efficiency of crop production. Herein, bacterial biosurfactant extracted from *Klebsiella sp*. strain RGUDBI03 (GenBank accession: ON945613.1) isolated from petroleum oil logged soil samples was used as a reducing and stabilizing agent for the synthesis of Ag NPs and ZnO NPs. The crude biosurfactant produced by the isolate was characterized by biochemical tests which showed the presence of amino acid and carbohydrate moieties and was further confirmed by FTIR spectral analysis. The bacterial cell-free extract consisting of the crude biosurfactant showed an E_{24} index of 36% against diesel oil and could collapse the drop of the oil-supplemented medium on a hydrophobic surface within 45 seconds. The Ag NPs and ZnO NPs were extensively characterized by SEM-EDX, TEM, XRD, FTIR, and DTA-TGA. The HR-TEM analysis confirmed the synthesis of well-dispersed Ag NPs and ZnO NPs with an average size range of 10-40 and 2-10 nm respectively. The Ag NPs and ZnO NPs primed rice (*Oryza sativa*) and chickpea (*Cicer arietinum*) seeds showed enhanced germination rate with an optimum dose of 30 mg/L ofNPs which also enhanced the seed water uptake, soluble sugar content, and amylase activity. The Ag NPs and ZnO NPs showed no cytotoxicity against red blood cells and also exhibited no environmental toxicity when tested on earthworms. The nano-treated earthworms demonstrated healthy gut physiology with healthy villi. The Ag NPs showed antimicrobial activity against plant pathogens *Ralstonia solanacearum* F1C1 and *Fusarium oxysporum* f. sp. pisi (van Hall) Synder & Hansen strain 4814, whereas, ZnO NPs exhibited no antimicrobial activity. Thus, the present study gives a complete snapshot of the biosurfactant-mediated green synthesis of Ag NPs and ZnO NPs, its application in enhancing the germination and growth of seeds, their antimicrobial activity against plant pathogens, cytotoxicity, and eco-toxicity assay, which advocates their futuristic potential for a field trial in future.