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Original Article

INFLUENCE OF ZINC OXIDE NANOPARTICLES ON GROWTH OF *SESAMUM INDICUM* L. IN ZINC DEFICIENT SOIL

S. NARENDHRAN*[1], P. RAJIV[1], RAJESHWARI SIVARAJ[2]

[1]Department of Biotechnology, School of Life Sciences, Karpagam Academy of Higher Education, Eachanari Post, Coimbatore 641021, Tamil Nadu, India, [2]Department of Chemistry, Government Arts College, Udumalpet, Tamil Nadu, India
Email: narendhransumathi@gmail.com

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ABSTRACT

Objective: A comparative examine of *L. aculeate* mediated ZnO (BZnO) and synthesized chemical ZnO (CZnO) nanoparticles became done which will decide the impact of seed germination on *Sesamum indicum* (CO-1).

Methods: Zinc oxide nanoparticles had been synthesized by the biological and chemical methods. Synthesized nanoparticles have been confirmed with Ultra Violet–visible spectroscopy (UV-Vis), Fourier transform infrared spectrometer (FT-IR), Energy dispersive X-ray spectrometer (EDX), X-ray diffractometer (XRD), Field Emission Scanning Electron Microscopy (FESEM) and High-Resolution Transmission Electron Microscopy (HRTEM). Different concentration of synthesized zinc oxide nanoparticles (0.1, 0.25, 0.5, 1 and 2 g/l) solution were prepared and applied to *Sesamum indicum* by soaking approach. The impact of ZnO nanoparticles treated plants were studied by using the standard procedure on plant growth attributes (shoot and root length, dry and fresh weight of shoot and root), photosynthesis pigment (chlorophyll a, chlorophyll b and total chlorophyll) and biochemical analysis (protein, carbohydrate and reducing sugar).

Results: The characterization analysis revealed that BZnO & CZnO NPs were spherical in shape with a mean particle size of 12±3 nm and 18±2 nm. The maximum observation of growth attributes was recorded in 0.5 g/l concentration of biologically synthesized ZnO nanoparticles which was compared to chemically synthesized ZnO nanoparticles.

Conclusion: Results of this experiment revealed that *Lantana aculeate* mediated zinc oxide nanoparticles are an enhanced useful resource of *Sesamum indicum*. It is able to use as nano fertilizer in agriculture development.

Keywords: Plant growth attributes, *Sesamum indicum*, Seed germination, Zinc oxide nanoparticles.

INTRODUCTION

Plants are very essential to human and their environment but very few studies were performed with ecological terrestrial test species to assess the potential toxicity of nanoparticles [1]. Plants are predicted to be uncovered to nanoparticles due to uptake and accumulation of plant biomass [2]. Nanoparticles have been absorbed to plant surface and soak up via natural nano or micrometer scale plant opening and could significantly have an effect on their delivery inside the environment.

Zinc oxide naturally occurs as mineral zincite and is mostly used as a white powder. Its material science, ZnO is an extensive band gap semiconductor of the II-VI semiconductor group. Zinc oxide is an amphoteric oxide almost insoluble in water and alcohol, but it is soluble in most acid including hydrochloric acid [3]. Zinc oxide crystallizes in two main forms, hexagonal wurtzite and cubic zincblende. The wurtzite structure is most stable at ambient condition. Various studies have been carried out on the effect of zinc on the growth and metabolism of the plant [4]. Zinc is an essential micronutrient for the growth and improvement of plants and human beings. Zinc performs the most important position in various metabolic techniques. Zinc is essential to trigger several enzymes and activate enzymes such as superoxide dismutase, tryptophan synthetase and dehydrogenases [5, 6].

Sesamum indicum is a member of the Pedaliaceae family and considered as a drought tolerant crop [7]. Sesame oil is used as foods (cooking and salad), medicine, soap manufacturing and so on. Its seeds and young leaves are eaten as stews and soups in Asia [8]. Sesamum oil is used as active ingredients in antiseptics, bactericides, disinfectants and antitubercular agents because they incorporate natural herbal antioxidants such as sesamin and sesamolin [9].

In the previous study, A simple, rapid biological procedure has been evolved to synthesize ZnO nanoparticles from *Lantana aculeate* leaf broth extracted solution and chemical synthesize ZnO nanoparticles by a precipitated method using Zn (NO_3) as a precursor. The synthesized nanoparticles have been characterized by various techniques which include UV-Vis, FTIR, XRD, EDX, FESEM and HRTEM. The biological and chemical synthesis of ZnO nanoparticles was spherical in shape with an average size of 12±3 nm and 18±2 nm. These results clearly indicate the benefits of using biological method synthesized ZnO nanoparticles have antimicrobial activities and also it could be effectively in agricultural development [10, 11].

Table 1: Nutritional value of deficient soil

Parameter	Deficiency soil
Soil texture	Sandy loam
Soil type	Reddish brown
Lime status	Calcareous
pH	8.12
EC	0.06 dS/m
Nitrogen	1.37%
Phosphorous	1.40%
Potassium	5.41%
Copper	0.60 ppm
Zinc	0.21 ppm
Iron	6.96 ppm
Manganese	3.65 ppm

MATERIALS AND METHODS

Materials

L. aculeate mediated (BZnO) nanoparticles and chemical mediated (CZnO) nanoparticles were synthesized with an average particle size (12±3 nm and 18±2 nm) and which determined through high-resolution